

Case study of the environmental permission procedure and the environmental impact assessment for power plants in Denmark

Krüger Nielsen, Stefan

Publication date:
1998

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Krüger Nielsen, S. (1998). *Case study of the environmental permission procedure and the environmental impact assessment for power plants in Denmark*. Roskilde Universitet. Tekster fra IMFUFA No. 348
<http://milne.ruc.dk/ImfufaTekster/>

General rights

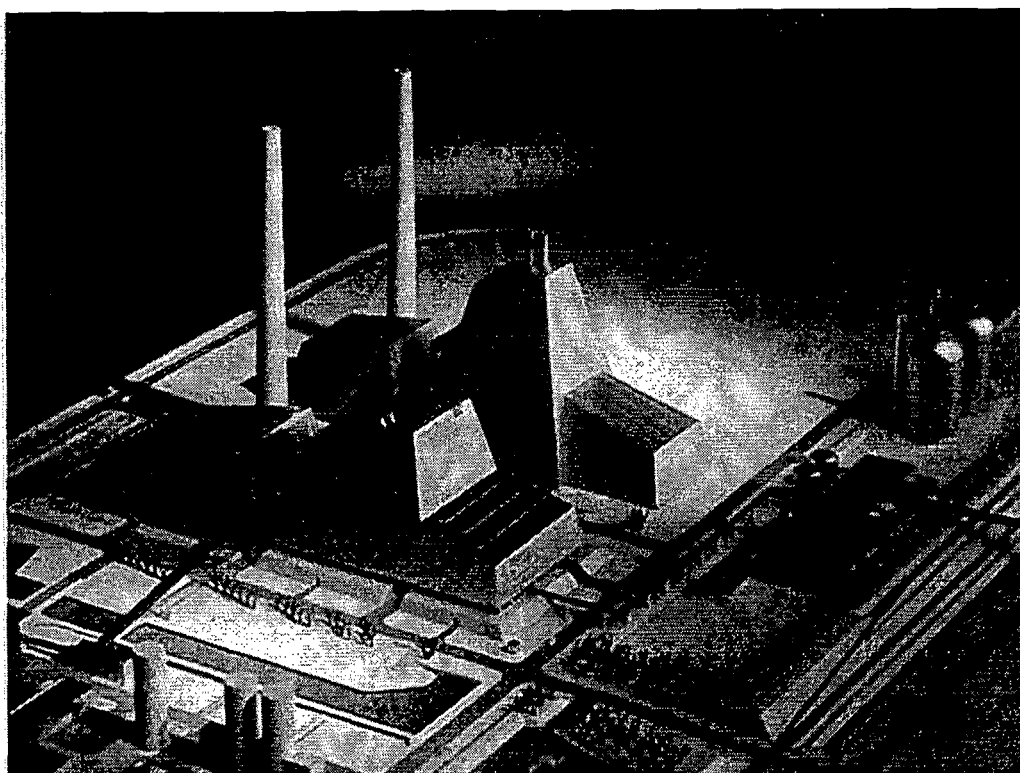
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain.
- You may freely distribute the URL identifying the publication in the public portal.

Take down policy

If you believe that this document breaches copyright please contact rucforsk@kb.dk providing details, and we will remove access to the work immediately and investigate your claim.

**Case study of the environmental permission
procedure and the environmental impact assessment
for power plants in Denmark**



MAY 1998

**By: Stefan Krüger Nielsen
Project leader: Bent Sørensen**

RUC, INSTITUTE 2
ENERGY & ENVIRONMENT GROUP

TEKSTER
IMFUFA

fra
ROSKILDE UNIVERSITETSCENTER
INSTITUT FOR STUDIET AF MATEMATIK OG FYSIK SAMT DERES
FUNKTIONER I UNDERVISNING, FORSKNING OG ANVENDELSER

IMFUFA, Roskilde Universitetscenter, Postboks 260, DK-4000 Roskilde, Danmark

Case study of the environmental permission procedure and the environmental impact assessment for power plants in Denmark

By: Stefan Krüger Nielsen
Project leader: Bent Sørensen

IMFUFA-tekst nr. 348/98 99 sider

ISSN 0106-6242

Abstract:

The Danish case study presented here is one out of a series of case studies carried out in a range of European Union Countries and Switzerland. These case studies have been conducted as part of a project sponsored by the European Commission, "Impact Assessment and Authorisation Procedure for Installations with Major Environmental Risks - Contract ENV4-CT96-0236, DGXII". One aim of the "Environmental risk" project is to carry out a range of case studies to describe and compare how and to which extent environmental concerns are integrated into the decision-making processes in different European countries when the authorities treat proposals to build installations with major environmental risks. Furthermore, the intention is to propose how the decision-making process could possibly be improved.

In September 1994 a Danish electric utility sent an application to the Danish authorities asking for permission to build a new major mainly coal fired combined heat and power plant, named "Avedøre 2", in the greater Copenhagen area in Denmark.

The County of Copenhagen was responsible of carrying out an environmental impact assessment (EIA) procedure according to the Danish law on planning. The EIA-procedure included two public inquiry's where the public was given the opportunity to state their opinions and to suggest alternatives. Furthermore the County was obliged to carry out an environmental permission procedure according to the Danish law on environmental protection. The County decided to approve the proposed plant as the local environmental impacts were considered to be acceptable. Furthermore the County stated that the alternatives to the plant which had been assessed in the EIA-procedure could also be approved if the Energy Agency later decided to reject the coal fired plant for national reasons.

The Minister for Environment and Energy and the Danish Energy Agency were obliged to assess the proposed plant's expediency according to the Danish law on electricity supply. The proposal to build a mainly coal fired plant was rejected due to its insufficient environmental performance as compared to other alternatives. Later the proposer sent in a new application for a mainly gas fired plant. This plant was approved by the Agency due to its better environmental performance. The Agency's main consideration was to fulfil the national CO₂ reduction scheme.

Opponents to the plant were mainly the local Municipality and the green organisations. They emphasised the need for carrying out a thorough assessment of alternatives to the central plant. Main alternatives such as electricity and heat savings, renewables and decentralised gas fired plants were claimed to be better mainly for environmental reasons.

The main conclusion of this report is that a thorough assessment of such alternatives proposed by the public is an essential part of the EIA-procedure. Therefore the report suggests changing the EIA-procedure in the future.

Contents:

CHAPTER 1 - INTRODUCTION.	1
CHAPTER 2 - SUMMARY.	2
SUMMARY OF OUR SURVEY OF THE DECISION-MAKERS' ATTITUDES TOWARDS THE PROPOSAL:	5
CHAPTER 3 - CONTENTS AND METHODOLOGY.	8
CHAPTER 4 - DANISH ENERGY PLANNING - UTILITIES AND THE ENVIRONMENT.	11
DANISH ENERGY PLANNING.	11
THE DANISH LAW ON ELECTRICITY SUPPLY.	12
REGULATION OF EMISSIONS FROM THE DANISH ELECTRICITY AND HEAT SECTORS.	13
<i>Emissions of SO₂.</i>	13
<i>Emissions of NO_x.</i>	13
<i>Emissions of CO₂.</i>	14
<i>Integrated Resource Management.</i>	15
<i>The biomass agreement.</i>	15
<i>Subsidies for decentralised CHP plants, wind turbines and other renewables.</i>	15
<i>The wind turbine scheme.</i>	16
CHAPTER 5 - STRUCTURE OF DANISH POWER AND HEAT SUPPLY.	17
STRUCTURE OF POWER AND HEAT SUPPLY IN EAST DENMARK.	17
PRODUCTION AND TRANSMISSION OF CHP.	18
<i>The production system.</i>	18
<i>Fuel use and efficiency of plants in the Copenhagen area.</i>	19
<i>The transmission and distribution system.</i>	19
CHAPTER 6 - SK POWER'S APPLICATIONS.	22
THE FIRST APPLICATION.	22
<i>SK Power's arguments for the need for an agreement with Vattenfall.</i>	22
<i>SK Power's arguments for the need for Avedøre 2.</i>	22
<i>The first application was rejected.</i>	23
THE SECOND APPLICATION.	23
<i>The approval of the second application.</i>	23
CHAPTER 7 - DATA SUMMARY FOR AVEDØRE 2 AND ALTERNATIVES.	24
TECHNICAL DESCRIPTION OF THE APPROVED AVEDØRE 2 PLANT.	24
ENVIRONMENTAL DATA FOR THE APPROVED AVEDØRE 2 PLANT.	25
<i>Emissions to the air.</i>	26
<i>Modelling the concentrations of NO_x and SO₂ and heavy metals in the air near by the plant.</i>	28
ALTERNATIVES CONSIDERED BY THE PROPOSER.	30
<i>The assumptions behind the comparisons.</i>	31
THE PROPOSER'S COMPARISON OF ALTERNATIVES.	31
<i>Fuel use.</i>	31
<i>Emissions of CO₂, SO₂ and NO_x.</i>	31
<i>Economical competitiveness.</i>	32
CHAPTER 8 - ENVIRONMENTAL APPROVAL OF POWER PLANTS IN DENMARK.	34
ENVIRONMENTAL PROTECTION IN DENMARK.	34
THE EUROPEAN COMMUNITY COUNCIL'S DIRECTIVE ON EIA.	35
THE PROCEDURES FOR EIA AND ENVIRONMENTAL PERMISSIONS FOR MAJOR POWER PLANTS IN DENMARK.	35

CHAPTER 9 - EARLIER POWER PLANT TREATMENTS.	39
TREATMENT OF THE NORTH JUTLAND POWER PLANT PROPOSAL.	39
<i>Summary of the treatment.</i>	39
<i>The main criticism raised in the public debate and lessons learned.</i>	44
<i>Lessons learned for the overall Danish energy debate.</i>	44
<i>Lessons learned for the EIA-procedure.</i>	46
CHAPTER 10 - IDENTIFICATION OF KEY PLAYERS AND ISSUES.	48
THE AUTHORITIES' TREATMENT.	48
THE PUBLIC DEBATE.	49
CHAPTER 11 - SURVEY OF DECISION-MAKERS.	52
INTERVIEWS PERFORMED.	52
METHODOLOGY.	52
OUTCOME OF THE SURVEY.	53
<i>Is the plant needed?</i>	53
<i>Which technology is preferable?</i>	54
<i>Which type of fuel is preferable?</i>	54
<i>Which site is preferable?</i>	55
<i>The EIA-procedure and the EIS-report.</i>	56
<i>Environmental concerns.</i>	57
<i>Which energy future would you prefer for Denmark?</i>	58
CHAPTER 12 - PREPARATION OF THE AUTHORITIES' TREATMENT AND EARLY OBJECTIONS FROM OPPONENTS.	60
PREPARATION OF THE AUTHORITIES' TREATMENT.	60
EARLY OBJECTIONS FROM OPPONENTS.	60
CHAPTER 13 - THE COUNTY'S EIA-PROCEDURE.	64
THE COUNTY WAS RELUCTANT TO CARRY OUT THE EIA-PROCEDURE.	64
THE OUTPUT OF THE FIRST PUBLIC INQUIRY.	65
THE ENVIRONMENTAL IMPACT STATEMENT.	66
THE OUTPUT OF THE SECOND INQUIRY PROCESS.	67
THE FINAL OUTPUT OF THE COUNTY'S REGIONAL PLANNING PROCESS.	67
CHAPTER 14 - THE TREATMENT BY THE DANISH ENERGY AGENCY.	68
THE REJECTION OF THE FIRST APPLICATION.	68
<i>Disagreements at the technical level.</i>	71
THE APPROVAL OF THE SECOND APPLICATION.	72
<i>The Agency's attitude towards the heat savings alternative.</i>	74
<i>Involving the public?</i>	74
CHAPTER 15 - THE MUNICIPALITY'S APPEAL TO THE APPEAL BOARD.	76
THE MUNICIPALITY'S REACTION TO THE APPROVAL.	76
THE MUNICIPALITY'S APPEAL TO THE DANISH APPEAL BOARD FOR NATURE PROTECTION.	76
THE DANISH APPEAL BOARD FOR NATURE PROTECTION.	77
THE DECISION BY THE DANISH APPEAL BOARD FOR NATURE PROTECTION.	78
CASE-LAW DEVELOPED BY THE APPEAL BOARD AND OPPONENT'S CRITIQUE.	79
THE MUNICIPALITY OF HVIDOVRE'S APPEAL TO THE COURT OF JUSTICE.	79
THE MINISTRY FOR ENVIRONMENT AND ENERGY TAKES OVER THE LOCAL PLANNING PROCEDURE.	79
CHAPTER 16 - THE COUNTY'S ENVIRONMENTAL PERMISSION AND THE APPEAL.	81
THE COUNTY'S ENVIRONMENTAL PERMISSION.	81

THE MUNICIPALITY'S APPEAL TO THE DANISH ENVIRONMENTAL PROTECTION AGENCY.	81
CHAPTER 17 - CONCLUSIONS AND RECOMMENDATIONS.....	82
THE DANISH EIA-PROCEDURE.....	82
PROPOSAL FOR OPTIMISATION OF THE EIA-PROCEDURE.....	83
CHAPTER 18 - POSTSCRIPT - COMPARISON TO OTHER EUROPEAN EIA STUDIES.	85
CHAPTER 19 - APPENDIXES.	88
CHAPTER 20 - WORDS, CONCEPTS, NAMES AND ABBREVIATIONS.....	90
CHAPTER 21 - LITERATURE	94

Chapter 1 - Introduction.

In September 1994 a Danish electric utility sent an application to the Danish authorities asking for permission to build a new major combined heat and power (CHP) plant, named "Avedøre 2", in the greater Copenhagen area in Denmark. This report presents a case study of the decision-making process in connection to the authorities' treatment of the application. The aim of the study is to describe how and to which extent attention has been given to environmental concerns in the decision-making process.

The Danish case study presented here is one out of a series of case studies carried out in a range of European Union Countries and Switzerland. These case studies have been conducted as part of a project sponsored by the European Commission, "Impact Assessment and Authorisation Procedure for Installations with Major Environmental Risks"¹. One aim of the "Environmental risk" project is to carry out a range of case studies to describe and compare how and to which extent environmental concerns are integrated into the decision-making processes in different European countries when the authorities treat proposals to build installations with major environmental risks. Furthermore, the intention is to propose how the decision-making process could possibly be improved.

This report aim at presenting a series of themes that are considered relevant for the understanding of how Danish authorities treat proposals to build power plants, how the public is involved in the process and how and to which extent environmental concerns are integrated into the decision-making process. The themes presented in the report are:

- Danish energy policy goals and the authorities' environmental regulation of electric utilities.
- Structure of Danish power and heat supply.
- Description of the proposed plant and the proposer's reasons for proposing it.
- Description of proposed alternatives to the plant.
- Description of the authorities' permission procedure for power plants
- Description of how the European Council's Directive on EIA (Environmental Impact Assessment) has been integrated into Danish law.
- Description of the EIA-procedure for earlier power plant treatments.
- Description of the authorities' treatment of the Avedøre 2 power plant proposal, with focus on the integration of environmental concerns into the decision-making process and involvement of the public.
- Description of proposals for improvement of the Danish EIA-procedure.

The case study presented in this report was carried out in the period from February 1997 to May 1998. It should be noted that the report is a primary version. Its purpose is to present results to Danish decision-makers and others who have shown interest for the work. This will be done at a seminar that is to be held 3 June 1998 at Roskilde University, Institute 2. Hereafter it is the intention to elaborate a final version of the report, in which the comments given by the decision-makers and others participating at the seminar will be added.

¹ Full project title is: "Impact Assessment and Authorisation Procedure for Installations with Major Environmental Risks"¹, Contract ENV4-CT96-0236 (Environmental Risk), DG XII.

Chapter 2 - Summary.

Type of project: CHP plant based on highly efficient multi-fuel concept. First proposal was to build a mainly coal fired plant with minor use of natural gas, heavy fuel oil and biomass (straw). However the first proposal was turned down by the Danish Energy Agency and the Minister for Environment and Energy, because coal was considered to emit too much CO₂. Therefore a new proposal was made to build the same type of plant without coal equipment. The plant is therefore to be fired with mainly natural gas and biomass (straw) and some additional heavy fuel oil as back-up fuel. This project has been approved by the authorities.

Purpose of project: There are several purposes with the plant. The plant is part of the proposer's plan to renew the energy production system in the Copenhagen area and to sell 40% of the plant to a Swedish energy company, Vattenfall, in return for some hydro power production capacity in Sweden. The proposer mentions the two following parameters as arguments for the expediency of the agreement with Vattenfall in their application to the authorities for permission to build Avedøre 2:

- Proposer gets access to cheap and environmentally sound hydro power from Sweden.
- The agreement will impose a strategic strengthening of the proposer's position on a future open and liberalised market for electricity within the European Union.

The reason why the proposer wants to build the plant:

- To meet the government's quotas for SO₂, NO_x and CO₂.
- To modernise the production system.
- To meet the Danish government's goal for use of biomass as fuel.
- To be able to cover the growing need for district heat in the Copenhagen area with CHP production.
- To improve the company's competitiveness.
- To export the multi-fuel concept to other countries by having a highly efficient reference plant in Denmark that can demonstrate the viability of the technology.

Proposer:

- The Danish electric utility SK Power.

Actors who preferred coal as a fuel:

- The proposer SK Power and the other utilities situated on Zealand.
- Danish Metal Workers Union.
- Danish Industries' association.
- The Conservative Party.
- The Liberal Party.
- The Centre Democrats' Party.
- Part of the Social Democrats' Party.

Actors who preferred gas as a fuel:

- The Social-Liberal Party.
- Part of the Social Democrats' Party (the Minister for Environment and Energy, who was responsible to give permission to build the plant, also preferred gas).

Actors who were against a centralised plant (but for a gas fired plant if it was to be built

- Danish Special Worker's Union.
- Greenpeace Denmark.
- The Energy Movement.
- The Organisation for Preservation of Nature.
- The Ecological Council

- anyway):**
- The Municipality of Hvidovre (The local area where the plant is to be situated).
 - The Socialist Party.
 - The Left Wing Coalition.

Milestones:

- **Planning:** In the 1980'ties the proposer planned to build a whole series of CHP plants at the Avedøre site. The first plant went into operation in 1990. Already then space was put aside for the proposed plant and some infrastructure for the plant was built too.
- **Concrete plans:** June 1994: The Avedøre 2 concept and the agreement with Vattenfall is approved by the Municipality of Copenhagen's City Council and ELKRAFT's board of directors.
- **Application:** September 1994: The proposer applies for the authorities' approval to build a mainly coal fired plant.
- **Inquiry in the Parliament:** November 1995: The Parliament's Energy Political Committee arranges an inquiry in the Parliament about the plant.
- **Public inquiries:** Two public inquiries are carried through by the County of Copenhagen in 1995/1996.
- **Inquiry:** February 1996: The Parliament's Council on Technology Evaluations arranges an expert inquiry about the plant. Utilities, the Ministry, the green organisations and university professionals are represented.
- **Impact Study:** Winter/spring 1996: The County of Copenhagen publishes the Environmental Impact Statement (EIS) report.
- **Energy 21:** April 1996: The Minister for Environment and Energy delivers a written statement about the energy plan "Energy 21" to the Parliament. This is important for the case as the plan suggests that coal should be phased out as a fuel for electricity production before 2030.
- **Rejection:** June 1996: The Minister for Environment and Energy rejects the application to build a mainly coal fired plant.
- **Appeal:** June 1996: The proposer appeals the decision to the Ministry for Environment and Energy.
- **Rejection:** July 1996: The Ministry for Environment and Energy rejects the appeal.
- **Coal stop:** February 1997: The government decides to announce a Danish coal stop, e.g. that no more coal fired plants should be built in the future.
- **New application:** March 1997: The proposer applies for the authorities' approval to build a mainly natural gas fired plant.
- **Approval:** March 1997: The Minister for Environment and Energy approves the application to build a mainly natural gas fired plant.
- **County approval:** May 1997: The County of Copenhagen decides upon approving the new project.

- **Appeal:** June 1997: The Municipality of Hvidovre appeals the County's approval of the plant to the Danish Appeal Board for Nature Protection. The Municipality claims that the County's treatment of the proposal has not been carried through in a legally correct manner.
- **Rejection of appeal:** December 1997: The Danish Appeal Board for Nature Protection accepts parts of the Municipality's appeal. However the Appeal Board decides that the County's treatment should not be disqualified anyway.
- **Local plan:** January 1998: The Municipality of Hvidovre still denies to make a local plan and to give the authorisation to start building the plant. Therefore the Ministry for Environment and Energy's Planning Department has taken over the obligation to make the local plan.
- **Writ:** The Municipality of Hvidovre writes the Danish Appeal Board for Nature Protection's decision to the Court of law claiming that the County's treatment ought to be disqualified.
- **Environmental permit:** March 1998: The County of Copenhagen gave the proposer an environmental permit.
- **Local plan:** The Ministry for Environment and Energy's Planning Department is carrying out a public inquiry process for the local plan from April 1998 and eight weeks ahead.
- **Appeal:** April 1998: The Municipality of Hvidovre appeal the County of Copenhagen's environmental permission to the Danish Environmental Protection Agency.
- **Authorisation to build:** Probably late 1998, however the exact date depends on the local plan and the building permit.
- **Authorisation to operate:** Probably late 2001 according to the proposer's own estimate.

Key concerns: The main issues discussed in the public debate have been:

- **CO₂ emissions:** The discussion whether coal is acceptable as a fuel for electricity production in Denmark in the future or if natural gas, biomass and renewables should be preferred to reduce emissions of CO₂.
- **Siting:** Local Municipality does not want the plant. Some actors believe that the production technologies should be placed closer to the consumers either by placing a central plant in the Municipality of Copenhagen or by implementing a series of decentralised plants.
- **Need:** Some actors think that the plant is not needed at all and proposes to save heat and electricity in stead or at least to build a smaller plant.
- **Technology:** Some actors think that other types of technologies would be better to use, e.g. decentralised technologies based on renewable energy, natural gas and biomass or heat and electricity saving technologies.
- **Labour:** Unions plead for work-intensive solutions and technologies favouring their own members.
- **Cleaner coal technologies:** Many actors prefer to continue refining the technologies for coal fired power plants in Denmark. Both boilers and environmental technologies have been developed to a high level by Danish manufacturers. These concepts can potentially be exported creating jobs in Denmark.
- **Natural gas:** The Danish gas sector is interested in speeding up the use of natural gas in Denmark. Mainly private companies handle the supply side, while transmission and distri-

bution are handled by the State and the local Municipalities.

- **Exports:** The proposer wants to have a highly efficient Danish demonstration plant that can later be exported. There is also an urge to use Danish components for the plant. Some Danish industrial companies are very interested in getting an approval of the coal fired plant as they are to deliver some of the components for the plant. These industries also hope that the concept will be exported in the future, so that they will have the chance to deliver components for plants in other countries too.
- **Cost:** The proposer prefers to use coal as a fuel because of the low cost compared to other fuels. The proposer is not interested in being dependent on the Danish gas supplier.
- **Competitiveness:** The proposer's aim is to strengthen the company's competitiveness by building a new efficient plant and by getting access to buy cheap hydro power.
- **EIA-procedure:** Many actors believe that the EIA-procedure has been an inadequate process as the County was not able to evaluate key concerns adequately and as the alternative proposals given to the County in the public inquiry process have not been assessed thoroughly.

Environmental concerns: Main focus is on reducing emissions of CO₂. There is also attention to reduction of emissions of NO_x and SO₂, but only minor attention to local environmental problems.

Special aspects: First commercial demonstration plant that is based on the multi-fuel concept with high energy efficiency.

Environmental performance: Will meet current Danish and EC regulations by a wide margin, except for the expected concentrations of NO_x in the local area. The immission limit for NO_x is only just met.

- Alternatives considered:**
- Alternative production technologies considered: Decentralised CHP plants, centralised plants of different sizes and with different types of boilers and gas turbines, and combined cycle plants.
 - Alternative fuels considered: Oil, natural gas, biomass (straw and wood chips) and coal. Coal is considered to emit too much CO₂.
 - Alternative sites in other Counties not considered sufficiently.
 - Heat savings considered but estimated to be too expensive and inefficient compared to substituting old plants with a new one. The assessment of heat savings is heavily criticised.

Summary of our survey of the decision-makers' attitudes towards the proposal:

	Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Need	<p>Fulfil strategic agreement with Vattenfall.</p> <p>Fulfil Danish energy policy goals: Reduce emissions, use more biomass as fuel.</p> <p>Modernise the production system.</p> <p>Cover growing heat needs by CHP.</p> <p>Economical com-</p>	No, the plant is not needed, especially not within the Municipality's own geographical borders.	NA, in principle the County has no official attitude towards this subject.	<p>Heat from CHP needed in the central Copenhagen area.</p> <p>Only way to reach CO₂ goal.</p> <p>Only way to fulfil biomass agreement.</p>	NA	<p>Plant oversized.</p> <p>Plant considered a bottleneck against the implementation of renewables and heat savings.</p>	No, the plant is not needed at all.

	Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
	petitiveness and strengthen international relations. Reference plant for exports.						
Technology	Central CHP. Multi-fuel concept gives cheaper fuels and the possibility to add coal burners later. Danish components.	Heat savings. Decentralised CHP. Not straw.	No preferences, in principle the County has no official attitude towards this subject.	No specific preferences. The important matter is if the technology can secure that the overall political goals can be fulfilled.	Heat and electricity savings. Decentralised CHP. Combined cycle gas plant. Fuel cell plant (future). Not add coal burners.	Heat and electricity savings. Decentralised CHP. Not add coal burners.	Heat and electricity savings. Not straw.
Fuel	Prefer coal as it is the cheapest, but accept gas as the government has declared a coal stop. Important to be able to shift between fuels.	Renewables preferred as they emit less CO ₂ .	No preferences, in principle the County has no official attitude towards this subject.	Gas and biomass preferred because they emit less CO ₂ than coal.	Against coal as it emits more CO ₂ than other fuels.	Against coal as it emits more CO ₂ than other fuels.	NA
Site	Avedøre site preferable because: Accessible by sea + highway, infrastructure already available, cooling water available, space available.	Not to be placed at Avedøre. Decentralised, close to consumers.	No preferences, in principle the County has no official attitude towards this subject.	No preferences.	No preferences.	Close to consumers.	Close to consumers.
EIA-process (+ good) (÷ bad)	+ Would have liked to have an acceptance from the Danish Energy Agency earlier whether the plant was needed or not. + All relevant information given.	+ The County should not have been responsible of carrying through the EIA-procedure. The procedure should rather have been made by Independent experts. Missing information in the EIS report: ÷ Heat savings not evaluated. ÷ Sites in other Counties not evaluated.	+ The County should not have been responsible of carrying through the EIA-procedure. The procedure should rather have been made by the Danish Energy Agency. The solution could be to take out the EIA obligation from the law on planning and to make a new separate law on EIA.	+ The EIS-report does not evaluate emissions to the air. + The EIS-report puts focus on local environmental problems.	+ The EIA-procedure was a fake process as the Danish Energy Agency knew that coal was not acceptable. Missing information in the EIS-report: ÷ The inquiry answers should have been put into the EIS-report in their full length. ÷ Furthermore the proposer's evaluation of the inquiry answers should have been sent on to all relevant actors. ÷ The calculation of emissions does not look far enough into the future. The Danish Energy Agency would have been able to make the EIA-procedure.	+ The County should not have been responsible of carrying through the EIA-procedure. The EIS-report should rather have been made by Independent experts. Missing information in the EIS-report: + The proposer's evaluation of the inquiry answers should have been sent on to all relevant actors. ÷ Some relevant economical and emission data were not available. ÷ Sites in other Counties not evaluated.	+ The County should not have been responsible of carrying through the EIA-procedure. The EIA-procedure should rather have been made by Independent experts. Missing information in the EIS-report: ÷ Heat savings not evaluated. ÷ Sites in other Counties not evaluated.

Environmental concerns	Primarily emissions to air: CO ₂ , SO ₂ , NO _x . Cooling water.	Local traffic. CO ₂ .	Only looked at local environmental problems such as use of water, truck traffic, noise and emissions of SO ₂ and NO _x .	Primarily emissions to air: CO ₂ , SO ₂ , NO _x . Ashes.	CO ₂ .	CO ₂ .	Do not use biomass. Truck traffic. Do not use gas reserves too fast.
Desired energy future	The proposers' considers themselves entrepreneurs of the official Danish energy policy. Therefore they will try to fulfil the political goals for the future energy system.	Renewables. Heat and electricity savings.	NA, in principle the County has no official attitude towards this subject.	Renewables, but gas preferable as a fuel until the energy system has been transformed in a more renewable direction, as gas emits less CO ₂ than coal.	Heat and electricity savings. Renewables.	Priority list: 1) Savings 2) Scrap coal + nuclear 3) Renewables 4) Natural gas. That is an energy future with less use of energy that should be produced by renewables.	Heat and electricity savings. Do not use Danish natural gas reserves too fast.

NA = Not asked or not answered.

Chapter 3 - Contents and methodology.

In this report we describe how environmental concerns have been integrated into the decision-making process in connection to the authorities' treatment of a proposal from a Danish electric utility to build a major CHP plant. The report is aimed at giving a description that is understandable to people in other countries than Denmark. This is important because the Danish case study is to be compared to a range of other European studies. A comparison of the different European studies requires a rather detailed impression of the technical, sociological, political and legislative framework within each country. It seems to us to be of notably importance to give at least a brief description of some of the underlying criteria that constitute the considerations made and the decisions taken in the Danish decision-making process and the attitudes towards the case of all the actors on the scene. Thus we find it necessary to describe the technical, sociological, political and legislative context in which the decision-making process is taking place.

First of all we have found it necessary to describe the development of national Danish energy policy since the first oil crises in the early 1970'ties. The national energy policy is of importance for this case study because the background for the electric utilities' choices of technology and site is to a great extent decided by this energy policy. The reason for this is, that the Danish electric utilities, which are mainly owned by the consumers or local municipalities, are regulated by governmental law on numerous points. The description is aimed at explaining how the overall political goals have lead to the formation of a strong tradition to regulate the utilities' environmental performance. The overall description of Danish energy policy and planning is given in **Chapter 4**.

Furthermore we have chosen to give a rather detailed technical description of the energy system in the area in question. This description is important to understand the technical context that constitutes the background for the electric utilities' wish to build the plant. The description of the structure of the energy system is given in **Chapter 5**.

In **Chapter 6** we describe the proposer's arguments why the plant is needed. The proposer's arguments are strongly connected to both the political and technical frameworks described in Chapters 4 and 5. The description of the proposer's arguments why the plant should be built is important as these arguments are the ones being tested by the authorities and the public through a range of public inquiry's and the authorities' more technical evaluation of the project.

In **Chapter 7** we give a brief technical description of the plant and a data Summary for the plant's environmental and economical performance. Furthermore Chapter 7 gives a thorough description of the technological alternatives to the plant that have been evaluated by the proposer on the request of the authorities, that is a description of the performance of different alternatives compared to the proposed project. Furthermore a description of the status quo alternative is given, that is what will happen if the project is not approved. The assessment of alternatives is an important part of the EIA-procedure and is therefore dealt with in detail.

In **Chapter 8** we give a brief description of how the environmental approval of major power plants is carried through in Denmark. In Chapter 4 the overall Danish energy policy goals for the electric utilities' environmental performance are described. These overall goals are supervised by the Danish Energy Agency. However, additional environmental regulation is being supervised by the local counties. The Counties carry out a treatment according to the regulations put out in the Danish law on environmental protection and the Danish law on planning. According to the law on environmental protection the Counties have to carry out a permission procedure, that is to assess whether an approved plant can have an environmental permission or not. Furthermore, according to the law on planning the counties have to carry out an environmental impact assessment (EIA) procedure that, among other things, include the elaboration of two public inquiry's. In Chapter

8 it is described how the regulations put out in the laws on environmental protection and planning supplements the treatment carried out by the Danish Energy Agency according to the law on electricity supply.

In **Chapter 9** we describe how environmental approvals of earlier power plant proposals in Denmark have been given in practice. We have chosen to put special attention to the latest treatment of an application to build two power plants in West Denmark. When these plants were approved EIA-procedures were carried through for the first time in Denmark, as power plants are concerned. We describe some of the main lessons learned from these first EIA-treatments as they have had major impact on the EIA-procedure concerning the Avedøre 2 plant. The reason for this is primarily that some local citizens appealed the County's treatment procedure to the Danish Appeal Board for Nature Protection two times. The Appeal Board's decisions to these appeals have since then created a precedent "case-law" directing the way the authorities treat proposals to build major power plants.

In **Chapter 10** we describe the regulatory and political framework for the approval of the Avedøre 2 plant in Denmark. We identify the key players that have been involved in the decision-making process and explain their roles in the process and the key issues discussed concerning the plant. The main aim with this Chapter is to argue which key players that are the most relevant to interview in our survey of decision-makers.

On the basis of the information's gathered in the earlier chapters we have developed a questionnaire that was used when carrying through a series of interviews with the most important key players in the decision-making process. We have interviewed representatives for the proposer, the opponents, i.e. the green organisations and the local Municipality, and the authorities that treated the application. In **Chapter 11** we describe in more detail the respondents' attitudes towards the project.

The focus of the case study is mainly aimed at describing to which extent the authorities' environmental regulation has been governing the electric utilities' choices of technology and site for the new plant, and to evaluate whether the authorities' authorisation procedure for the plant has included environmental concerns adequately in the decision-making process. In Chapters 12 to 15 we describe the authorities' treatment of the proposal and the public's participation in the decision-making process in more detail. This is primarily done on the basis of official documents delivered to us by the proposer, the authorities and the opponents, i.e. the green organisations and the local Municipality. The main aim is to describe the main milestones in the treatment process and to shed light on the background for the decisions taken in the decision-making process.

In **Chapter 12** we describe the preparation of the authorities' treatment and early objections from opponents. Both the authorities and the opponents have learned from the earlier treatment of the North Jutland Power Plant. The authorities have learned that alternatives will have to be assessed before deciding if the proposal can be approved. The opponents have learned that the County is not able or willing to assess alternatives outside its geographical borders. Therefore important decisions are already taken at this early step of the process, before the EIA-procedure have even started and therefore also before the public have been involved officially in the process.

In **Chapter 13** we describe the County's EIA-procedure concerning the proposal. The county carries through the environmental impact assessment and two public inquiry's. We give a short summary of the contents of the County's EIS-report. Furthermore we describe the comments given to the plant in the County's two public inquiry processes. The Chapter especially puts focus on the subjects not dealt with in the EIS-report and explains how these deficiencies have caused criticism from opponents.

In **Chapter 14** we describe the Energy Agency's treatment of the proposal. The Agency carries out a treatment according to the law on electricity supply, i.e. the Agency assesses whether the plant is in line with the overall national energy policy goals. The chapter especially puts focus on the arguments used by the Agency when rejecting the coal fired plant and when approving the revised gas fired version. These arguments are compared to the proposer's arguments as to explain their difference in attitudes towards the project. Fur-

thermore we describe how the Agency has been criticised for not involving the public directly in the decision-making process and for not explaining in depth the background for their decisions.

The local Municipality is in opposition to the proposal and has therefore appealed the decision to the Danish Appeal Board for Nature Protection. In **Chapter 15** we describe the contents of the Municipality's appeal and the Appeal Board's decision. The Municipality is also unsatisfied with the Appeal Board's decision. This has lead the Municipality to writ the Appeal Board to the Danish Court of Law.

In **Chapter 16** we describe in brief the County's environmental permission and an appeal from the local Municipality. The local Municipality is in opposition to the proposal and has therefore appealed the County's decision to give the plant an environmental permission to the Danish Environmental Protection Agency.

In **Chapter 17** we give our conclusions and recommendations. We present proposals on how the authorities' treatment of power plant proposals might possibly be optimised in the future as to integrate environmental concerns better into the decision-making process. It is suggested that the public should be genuinely involved in the decision-making process and that the authorities treatment process ought to be more open and transparent to the public. Especially alternatives to the plant proposed by the public should be assessed more thoroughly.

In **Chapter 18** we briefly summarise an interim comparison of the different European case studies elaborated for the "Environmental risk" project by Simon Dresner from the University of Surrey in Great Britain. It should be noted that the results presented are provisional. The comparison shows that there are many similarities connected to the opinions of respondents towards EIA-procedures in different European countries. We have added some comments to the general conclusions concerning which problems that might possibly be connected to comparing the studies.

In **Chapter 20** are listed words, names, concepts and abbreviations and **Chapter 21** contains a list of literature used.

Chapter 4 - Danish energy planning - utilities and the environment.

Danish energy planning.

The first official Danish governmental energy plan came out in 1976 as a consequence of the first oil crises. The Danish energy system was at that time highly dependent on oil as a fuel for electricity and heat production. The purpose of the first energy plan was to secure Denmark against supply crises and price increases like the one that came out of the first oil crises in 1973/74. Since this first energy plan came out, there has been a strong tradition to set the frame and put out the goals for the regulation of the energy sector by making national energy plans. The second Danish energy plan came out in 1981 after the second oil crises in 1979/80. The focus of this plan was on supply security and economically sound production.²

The main result of the two first Danish energy plans and the subsequent legislation was a fuel shift in the energy sector. The electricity and district heating production sectors shifted drastically from mainly using oil (approximately 80% in 1973) to mainly coal use (approximately 80% in 1989)³. The final end use of fuels for space heating also shifted drastically from mainly oil burning in private boilers to mainly district heating from centralised plants and a growth in the use of natural gas at the private consumers, as a result of the expansion of a new gas pipe line system throughout Denmark. Furthermore the high energy prices and more restrictive laws for the insulation of new houses led the consumers and the constructors of houses to insulate new houses better and to retrofit old houses with more insulation⁴. Generally the rising energy prices after the oil crises and new governmental regulation of the energy sector led to changes in fuel use and substantial reductions in heat use per square metre in dwellings.

In 1990 the energy plan "Energy 2000" was accepted by a broad majority in the Danish parliament. "Energy 2000" came as a follow-up on the Brundtland report which introduced the need for sustainable energy development, meaning that the industrialised countries have to use fewer resources such as fossil fuels to let people in the developing countries and future generations have the chance to use an equally amount of resources. Furthermore nature should be left in such a condition by the generations now living that future generations can be born to a similarly liveable world. The decisive new subject in "Energy 2000" was that the energy plan focused on the need to reduce the energy use and the environmental damages caused by energy production. Earlier Danish energy plans were all based on generous prognosis of future growth in energy production and use. Energy 2000 put focus on the need to transform the energy system in a more sustainable direction. The concrete goal in the plan was to reduce emissions of CO₂ from the energy sector by 20% within 2005 compared to 1988.⁵

Since "Energy 2000" came out, the fuel shift at the end users from oil to district heating and natural gas has continued, so that today more than 65% of the energy use for space heating is delivered as district heating or natural gas, this number was only 32% in 1980. Primary energy use for space heating has been reduced by 30% since 1973 despite that the heated area has grown by almost 45% in the same period.⁶ The production and use of electricity have been doubled since 1973 and this growth is continuing but at a lower pace. Most of the electricity is generated at centralised power plants, but the amount produced by wind turbines and decentralised natural gas powered CHP plants is growing⁷. The implementation of wind turbines and small scale decentralised natural gas powered CHP plants has been speeded up after the emergence of "Energy 2000", through subsidies to electricity produced by these technologies. Generally the CO₂-emissions from the Danish energy sector have been reduced by 4% in 1995 compared to 1988 despite the growth in activities, espe-

² Danish Ministry for Environment and Energy, 1996 (a), p. 9.

³ Danish Ministry for Environment and Energy, 1996 (a), p. 64.

⁴ Danish Energy Agency, 1995 (a), p. 22.

⁵ Danish Energy Agency, 1990.

⁶ Danish Energy Agency, 1995 (a), p. 22.

⁷ Danish Energy Agency, 1995 (a), p. 8.

cially in the transport sector. This reduction of CO₂-emissions has appeared thanks to the above mentioned development in the electricity and heat sector.

Energy 2000 has recently been followed up by a new energy plan "Energy 21" which came out in 1996. "Energy 21" confirms the goal of reducing the emissions of CO₂ by 20% in 2005 and suggests that it will be necessary to reduce CO₂-emissions further after 2005. One of the most controversial points in the new energy plan is that it presents two "scenarios" for the future development of the Danish energy system.

One of these "scenarios", denoted the "planned development", presents the idea that, before 2030 coal should be phased out as a fuel and the emissions of CO₂ should be halved compared to 1990. The planned development is an example of how the recent Danish government would like the Danish energy sector to develop if other highly industrialised countries are ready to commit themselves to the same kind of development.⁸

The other "scenario", denoted the "reference development", presents what will happen in the energy sector if the existing Danish energy policy is carried out without further regulations of the energy sector. The result of the reference development is that the final end use of energy will grow by 22% between 1994 and 2030. The CO₂ reduction goal from "Energy 2000" in 2005 is not accomplished as the CO₂-emissions are only reduced by 12% in 2005. Hereafter the CO₂ emissions are expected to rise further by 5% until 2030.⁹

Since the energy plan "Energy 21" came out the present Danish government has made a decision to stop further expansion with new power plants that use coal as a main or minor fuel¹⁰. However a large fraction of the political opposition in the Danish Parliament are ready to reject the decision if they gain the majority after the next election.¹¹

The Danish law on electricity supply.

The Danish law on electricity supply secures that the electricity supply is carried out in a way so that it fulfils a series of environmental and socio-economic interests as defined by the government in the above mentioned energy plans. The most important matters in the law on electricity supply that are relevant for this report are that:

- It is the Minister for Environment and Energy who has the authority to give the utilities permission to build new production plants. Furthermore he is given the opportunity to decide which kind of fuel and which kind of production plants the utilities can get the permission to use. Therefore he is also authorised to reject applications from the utilities to build power plants if these are somehow conflicting with the overall Danish energy policy stated in the government's energy plans, for example by using technologies that are not efficient or which use fuels with great environmental hazards.
- The law secures that the utilities' electricity prices can only cover expenses for fuel, wages, other operating expenses, administration and accumulation of capital for investments in new production facilities. In this way the Danish electricity sector is run as non profit firms, which secure very low electricity production prices. The law obliges the electric utilities to produce as economically as possible within the framework defined by the government's energy policy.¹²

The Danish law on electricity supply has been the government's main instrument to steer the electricity sector since it was first defined in 1976. The law on electricity supply has secured the government a sovereign control with the sector's environmental and socio economical performance.

⁸ Danish Ministry for Environment and Energy, 1996 (a), p. 71.

⁹ Danish Ministry for Environment and Energy, 1996 (a), p. 59-64.

¹⁰ Press release from the Danish Energy Agency", 11.02.1997.

¹¹ Holdum, 13.03.1997 and Langkilde, 20.03.1997.

¹² Government notice, 01.07.1996.

Regulation of emissions from the Danish electricity and heat sectors.

Environmental regulation of the electric utilities in Denmark has been strengthened through the 1980'ties and 1990'ties with the energy plans described above and the resulting initiatives, e.g. legislation. The electric utilities' main contribution to environmental problems is considered to be stack emissions that contribute to regional and global environmental effects such as acidification and global warming. Therefore the main focus of environmental regulation of the electric utilities is on reducing stack emissions of SO₂, NO_x and CO₂.

Emissions of SO₂.

In 1985 Denmark signed the first sulphur protocol in Helsinki. The aim of this protocol was to secure that the emissions of sulphur to the air were reduced by at least 30% compared to the 1980 level¹³. Recently Denmark has signed a new sulphur protocol that obliges Denmark to reduce the emissions of SO₂ by 80% during the period 1980 to 2000¹⁴.

The electric utilities' contribution to reaching the overall national goal of SO₂-reductions has been ensured by committing the utilities to reduce the emissions below certain quotas. The Danish Energy Agency decides upon national quotas and the utilities' main organisations ELKRAFT and ELSAM decides how to share the effort to reach the overall goal. ELKRAFT's¹⁵ quota for 2005 is 19.000 tonnes, corresponding a reduction of 40% compared to 1997.

The utilities can reduce SO₂-emissions per energy unit delivered to the consumers by using filters for the stack air, by improving the efficiency of the energy production, transmission and distribution system and by using "cleaner" fuels, for example by substituting normal coal by coal with low sulphur content or by natural gas. The filter technique can reduce the SO₂-content in the stack air by 85%.¹⁶

Emissions of NO_x.

In 1988 a protocol was signed in Sofia that obliges the contracting countries to freeze the emissions of NO_x at the 1987 level in 1994. Denmark has, together with 11 other countries signed a declaration in connection to the NO_x-protocol that obliges the countries to reduce the emissions of NO_x by 30%, compared to a year between 1980 and 1986 chosen by the member states themselves, as fast as possible and before 1998 at the latest¹⁷. In the latest Danish energy plan it is stated that the emissions of NO_x should be reduced by 30% in the period from 1986 to 1998¹⁸. Ongoing negotiations within the European Community on a tightening of the quotas points at the need to reduce the emissions by 37% compared to 1997. However this quota has not yet been finally settled.¹⁹

The electric utilities' contribution to the national NO_x-reduction goal is decided by quotas set by the Danish Energy Agency and the utilities can reduce the emissions of NO_x per energy unit by using filters for the stack air, substituting old burners with low-NO_x burners and by improving the energy efficiency of the total energy production, transmission and distribution system. ELKRAFT's NO_x quota corresponds to a reduction of the emissions of more than 50% before 2005 compared to 1997.²⁰

¹³ Government notice, 15.12.1987.

¹⁴ Danish Ministry for Environment and Energy, 1996 (a), p.20.

¹⁵ ELKRAFT is the co-operation for the utilities in eastern Denmark.

¹⁶ ELKRAFT, 1994 (a), p. 34-35.

¹⁷ ELKRAFT, 1994 (a), p. 19.

¹⁸ Danish Ministry for Environment and Energy, 1996 (a), p.20.

¹⁹ ELKRAFT, 1998, p.31.

²⁰ ELKRAFT, 1998, p. 50.

Emissions of CO₂.

Denmark has signed the United Nations' Climate Convention, which means that the Danish government aim at reducing the emissions of greenhouse gasses to the atmosphere in the future. As mentioned earlier, this obligation is the keystone in the Danish government's latest energy plan, "Energy 21"²¹. In this energy plan the Danish government has incorporated the goal of achieving a 20% reduction in the emissions of carbon dioxide related to energy use before 2005 compared to 1988. Furthermore it is mentioned in the plan that much greater reductions in the emissions of carbon dioxide will be needed in the future to avoid the possible danger of the enhanced greenhouse effect, (global warming). Beyond 2005 the government has not yet settled on any specific goal for the necessary reduction in emissions of carbon dioxide, but it is mentioned in the plan that a 50% reduction compared to the 1990 level might be needed before 2030.

Before the international conference on climate change in Kyoto in December 1997 the Danish government has agreed upon a common EU strategy to reduce the emissions of greenhouse gasses. At the Kyoto meeting the European Union's environmental ministers decided to propose a 15% cut in emissions by industrialised countries in 2010 compared to 1990. In this forum Denmark together with Germany and Austria accepted to cut emissions by 25% before 2010 as compared to 1990²². The result of the Kyoto meeting was that the EU countries have to reduce emissions by at least 8% before 2012. The reduction goal has been set for six greenhouse gasses altogether. The concrete distribution of reductions of each type of gas and the overall distribution among the EU countries has not yet been settled.²³

The Danish government's reduction goals for the energy sector as a whole has not been implemented in the government's latest plan for reduction of CO₂ emissions from the transportation sector, "The Government's action plan for reducing the emissions of CO₂ from the Danish transport sector"²⁴, released in 1996. The goals for the transportation sector are thus less progressive than the goals for the other energy consuming sectors. The government aims at this sector to stabilise carbon dioxide emissions at the 1988-level in 2005 and further achieve a reduction of 25% before 2030 compared to the emission level in 1990. Therefore the other energy consuming sectors, especially the electricity supply sector, will have to contribute more to the reduction of carbon dioxide if the overall goal for the energy sector is to be reached²⁵. Furthermore it should be mentioned that the emissions of CO₂ from the transport sector have increased by 16% as compared to 1988²⁶. The government's reduction plan for the emissions of CO₂ has become one of the major obligations for the Danish electric utilities.

Recently the Ministry for Environment and Energy has sent a report to the Parliament's Committee on Energy issues describing Danish energy policy and future efforts. One main conclusion is that the fact that the emissions of CO₂ have only been reduced by 4% compared to 1988 calls for new incentives if the overall reduction goal for 2005 is to be reached. One new incentive mentioned is that it might be necessary to establish CO₂ quotas for the utilities in Denmark. This would be a new way of regulating the utilities²⁷. The Danish CO₂ reduction goal has previously been set out for the correlated emissions, i.e. the emissions generated by production of electricity for exports have been excluded. Whether the reduction goal will be changed to include also emissions from exports is not yet settled, but the Ministry's intention to put out quotas for the utilities points in that direction. The consequence of putting out quotas on the utilities emissions CO₂ might very well restrict the utilities from producing huge amounts of electricity for exports based on fossil fuels as it has been the case in the last years.

²¹ Danish Ministry for Environment and Energy, 1996 (a).

²² Auken, 15.12. 1997.

²³ Telephone interview with Jesper Gundermann from the Danish Energy Agency, 17.02.1998.

²⁴ Danish Ministry for Transport, 1996.

²⁵ Danish Ministry for Environment and Energy, 1996 (b) and Danish Parliament, 1996.

²⁶ Danish Ministry for Environment and Energy, 02.04.1998.

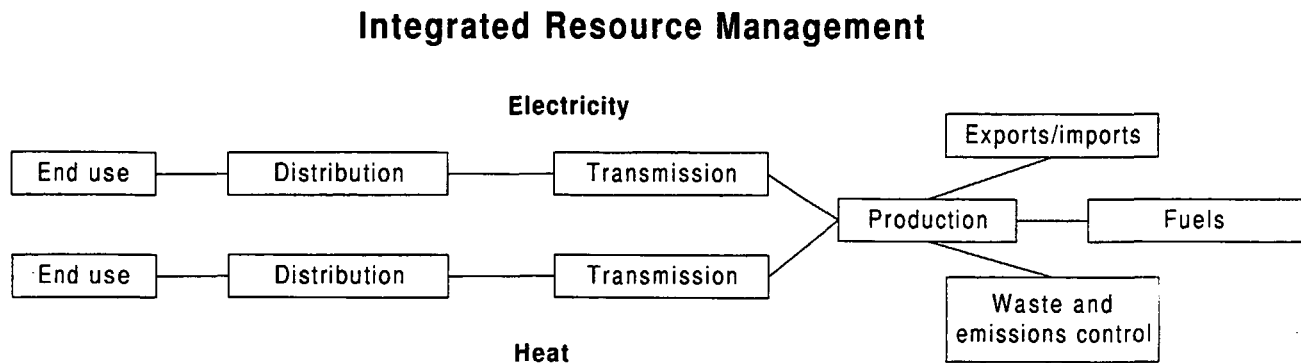
²⁷ Danish Ministry for Environment and Energy, 02.04.1998.

Integrated Resource Management.

The electric utilities in Denmark are obliged to fulfil the environmental goals in the government's energy plans by optimising the total energy system from fuel use over more efficient production, transmission and distribution to final end use at the consumer. The utilities' obligation to make efforts on the consumer side is fairly new, as it was integrated into the Danish law on electricity supply in 1994²⁸.

Thereby the electric utilities' environmental obligations are no longer concentrated solely on optimisation of production, transmission and distribution but also on the final end use. This is actually a controversial task, as energy producers traditionally aim at selling as much energy as possible. This new obligation is important for this case study because the utilities are supposed to quantify the environmental benefits for a number of alternatives, also on the consumer side, before choosing which technology that will be the most suitable to invest in for the future.

Figure 1



The biomass agreement.

In 1993 the Danish government (consisting of the following parties: The Social Democrats, the Social-Liberals, the Centre Democrats and the Christians) made a broad political agreement with the Conservative Party, the Liberals and the Socialists. It was decided to demand that the electric utilities should use at least 1,2 million tonnes of straw and 0,2 million tonnes of wood chips on a yearly basis in 2000 at the latest. The agreement was made to promote substantial use of biomass for energy purposes in Denmark. The underlying arguments for the agreement were many, but one major consequence of interest for this case study is that the biomass agreement forces the electric utilities to use quite substantial amounts of biomass for energy production in the future. Biomass as fuel for energy production is considered as being less CO₂-emitting than coal, oil and gas, due to the initial assimilation of CO₂ by plants. Thereby the biomass agreement is considered to be a major tool to reduce the CO₂-emissions from electricity production in Denmark.²⁹ In the "Energy 21" plan it is estimated that approximately 10% of the total fuel use for power and heat production will be biomass in year 2000. Besides this the use of bio-gas and refuse gas will contribute further³⁰. The goals put out for the utilisation of biomass can not be reached for year 2000 because the implementation of biomass fired CHP plants has been slower than expected. However the Danish Government still confirm that the goal is to be reached.³¹

Subsidies for decentralised CHP plants, wind turbines and other renewables.

A Danish law has secured an environmental externality related tax rebate of 0,1 (DKr) per kWh electricity produced by decentralised natural gas powered CHP plants or by production technologies based on renew-

²⁸ Law on amendment of the Law on electricity supply (integrated resource management), 09.02.1994.

²⁹ Danish Parliament, 14.06.1993.

³⁰ Danish Ministry for Environment and Energy, 1996 (a), p.38.

³¹ Danish Ministry for Environment and Energy, 02.04.1998.

able energies or biomass, and additionally 0,17 (DKr) to electricity produced by renewable fuels or biomass³². However, the tax rebate for decentralised natural gas powered CHP plants has recently been reduced to 0,07 (DKr)³³ and there is an ongoing discussion whether the rebate for electricity generated by land based wind turbines also ought to be reduced³⁴.

This law has caused a fast expansion in the number of small scale decentralised natural gas powered plants and wind turbines implemented in Denmark in the last few years. This development has had an impact on the Danish utilities for a number of reasons. Probably the most important impact has been that small scale natural gas fired CHP plants are now economically viable and therefore many private consumers have seen the technology as a good investment. Thereby some of the electric utilities' market potential seems threatened, as they are "forced" by law to buy the electricity production from the decentralised plants that are not all owned by the utilities³⁵. The reason why the utilities have to buy electricity from decentralised power plants owned by other parties is that the utilities own and operate the Danish transmission grid. However in east Denmark the utilities own most of the decentralised plants while in west Denmark the decentralised plants are mainly municipality owned. The utilities in Denmark have chosen different attitudes towards the development of decentralised plants. The utilities in east Denmark have integrated the decentralised development in their own strategy while the utilities in west Denmark has concentrated solely on building central units.

The wind turbine scheme.

The Danish Parliament has asked the Government to aim at 1% annual increase in the share of renewables, in order to reach 35% of total supplies by 2030³⁶. According to the newest Danish energy plan electricity generated by wind turbines is planned to be a major contributor to this development.

With more than 1000 MW wind turbine capacity installed onshore Denmark already covers more than five per cent of its electricity consumption from wind energy. A law from 1996 obliges the utilities to install additionally 200MW wind turbine capacity before 1999³⁷. Current plans envisage 1,500 MW onshore by the year 2005, covering ten per cent of Denmark's electricity consumption³⁸. Furthermore there is a large potential to install wind turbines off shore in Denmark and the first two off shore wind turbine parks have already been installed. The Danish electric utilities together with the Danish Energy Agency have recently published a plan that envisages additional 4000 MW that can be installed offshore before 2030. According to the Danish Minister for Environment and Energy, Svend Auken, production from these offshore turbines can cover half of Denmark's electricity consumption in 2030³⁹. In 1998 the utilities have been obliged to install five new off shore wind turbine parks totalling 750 MW before 2008⁴⁰.

³² Law on subsidies for electricity production, 27.12.1994 and Law on amendment of the Law on electricity supply (Payment for electricity produced on decentralised CHP plants etc.), 20.12.1995.

³³ Stiesdal.

³⁴ Danish Council on Energy and Environment, 1998.

³⁵ Law on amendment of the Law on electricity supply (Payment for electricity produced on decentralised CHP plants etc.), 20.12.1995.

³⁶ Auken, 17.06.1997.

³⁷ ELKRAFT, 1998, p. 9 and Danish Ministry for Environment and Energy, 02.04.1998.

³⁸ Krohn, 1997.

³⁹ Auken, 17.07.1997.

⁴⁰ Danish Parliament, 13.02.1998.

Chapter 5 - Structure of Danish power and heat supply.

The Danish power system is divided into two systems serving west and east Denmark, which have not yet been connected directly⁴¹. In this report we only describe the east part of the energy system as our case study is dealing with an application submitted by the electric utility SK Power to build a major CHP plant in this area.

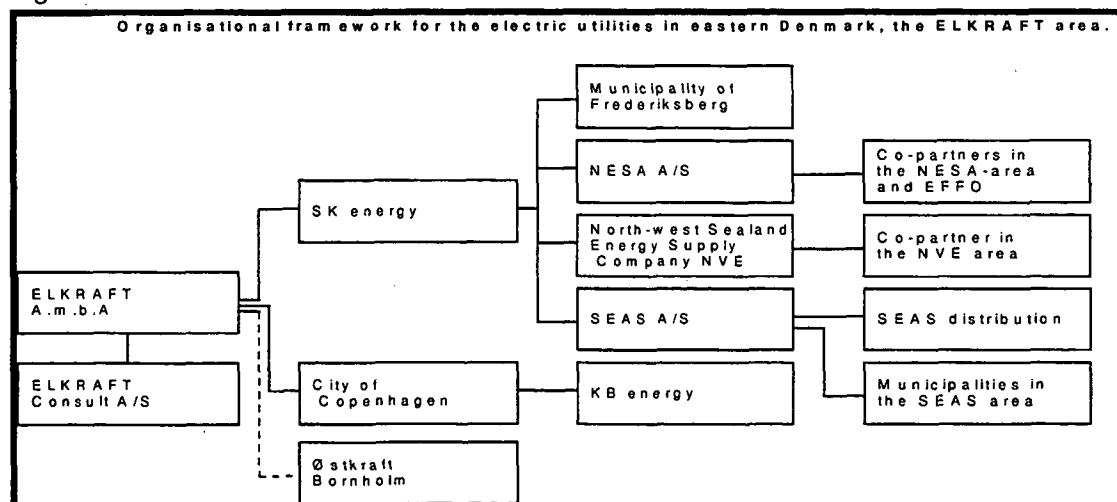
Structure of power and heat supply in East Denmark.

ELKRAFT is an umbrella organisation for all the power producers on Zealand.⁴² The producers' collaboration in ELKRAFT is mainly concentrating on the following tasks:

- Planning of future co-owned production plants.
- Optimisation of the daily energy production on Zealand so that the production is always carried out on the most efficient and economic plants.
- Co-operation with utilities in other countries with respect to imports and exports of electricity.
- Co-ordinated purchases of fuel to obtain the best price.
- Planning and management of the overall electrical transmission system.⁴³

In 1992 a major restructuring of the organisational basis of the electric utilities in the ELKRAFT area was carried out. The entire electricity production was gathered in two major companies namely SK Power and KB Energy which owns 80% and 20% of ELKRAFT, respectively. KB Energy is owned by the city of Copenhagen⁴⁴ while SK Power, which is a joint stock company is owned by several distributors, namely NESA (59%), SEAS (25%), NVE (13%) and the Municipality of Frederiksberg (3%)⁴⁵. NESA, which is the major stock holder is owned by the Municipality of Gentofte (56,7%), the County of Copenhagen (22%), the Swedish energy company Vattenfall⁴⁶ (10,5%) the County of Frederiksborg (2,5%), the County of Roskilde (0,2%) and other small stock holders.⁴⁷ In this way most of the energy production system in the ELKRAFT area is owned by local Municipalities and Counties and only a rather small fraction by a Swedish energy company.

Figure 2



Sources: ELKRAFT, 1995 (b) and SK Power, 1994.

⁴¹ Sea cables from western Denmark to Norway and Sweden, land based connection from western Denmark to Germany and sea cables from eastern Denmark to Sweden and Germany indirectly connect the two parts of the electricity production system.

⁴² The power producer on Bornholm, which is an island in the Baltic Sea, is also part of ELKRAFT. However, in this report we concentrate on Sealand.

⁴³ Danish Energy Agency, 1991.

⁴⁴ ELKRAFT, 1995 (b).

⁴⁵ Clausen, 02.11.1996.

⁴⁶ Henriksen, 03.09.1996.

⁴⁷ Henriksen, 17.05.1996.

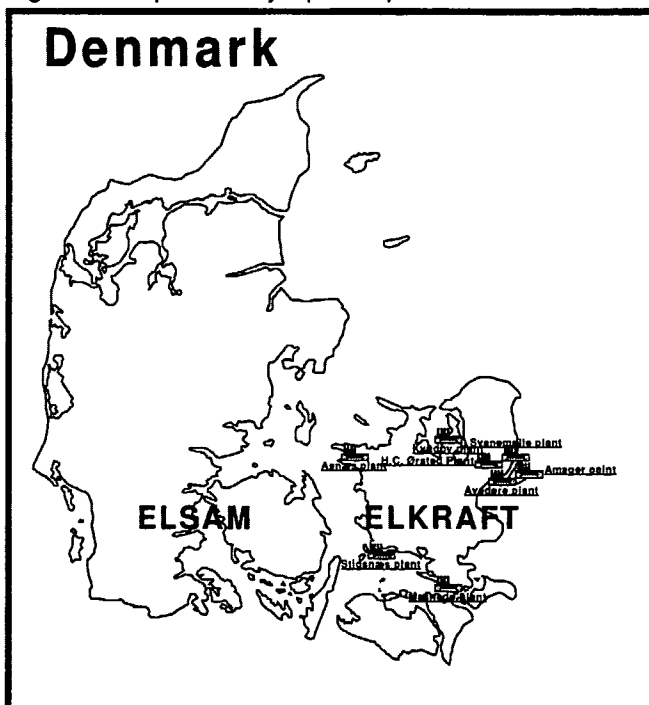
The distribution of electricity on Zealand is managed by 23 consumer-owned companies, which are either owned by municipalities or by private consumers. Two of these distribution companies are also producers, i.e. vertically combined organisations. These are KB Energy and SEAS⁴⁸. The district heating companies on Zealand are similarly organised as they are all owned by the consumers or municipalities⁴⁹.

Production and transmission of CHP.

There is a long tradition of using district heat systems to deliver heat for buildings in the city of Copenhagen, where the first CHP plant was established already in 1908⁵⁰. The main reason is that the co-production of power and heat makes it possible to use the associated output from the production of electricity, namely heat, for space heating in houses. This raises the fuel efficiency of the energy production and allows cheaper production than would be achieved in an energy system based on pure power or heat plants. The establishment of the district heating transmission and distribution system and the connected heat- and CHP plants has been rapidly expanding. The production of CHP has tripled since the 1970'ties as a result of the construction of two major CHP plants (Amager 3 and Avedøre 1), and the establishment of a new transmission system and an expansion of the distribution system as a result of many new district heating consumers in the greater Copenhagen area.⁵¹ This development is expected to continue as more consumers shift from other sources of space heating to district heating.

The production system.

Figure 3: Map with major power plants on Zealand.



The heat production in the greater Copenhagen area is supplied by 9 base-load installations consisting of a mix of waste incineration plants, other waste treatment plants with energy production and CHP plants, and furthermore approximately 45 peak-load stations and some industries with surplus heat production. SK Power owns one of the four major CHP plants in the area, the Avedøre 1 plant, while KB Energy owns the other three major CHP plants, Amager Power Plant, H.C.Ørsted Power Plant and Svanemøllen Power Plant. While

⁴⁸ Danish Energy Agency, 1991, p. 30-32.

⁴⁹ Danish Energy Agency, 1991, p. 33-34.

⁵⁰ KB Energy, 1992, p. 68.

⁵¹ ELKRAFT, 1993 (a), p.9.

KB Energy only owns plants in the greater Copenhagen area, SK Power owns all the major plants on the rest of Zealand and most of the minor plants too. Outside the Copenhagen area SK Power owns the power plants in Asnæs (the biggest plant in Denmark), Kyndby, Stigsnæs and Masnedø.

Most of SK Power's production plants on Zealand are very old producing at a relatively low electric efficiency and are not equipped with modern environmental technologies. Furthermore only a minor share of the heat production at these plants is actually used for district heating. Therefore the environmental performance of these plants is relatively low compared to modern CHP plants. SK Power wants to build an additional new major CHP plant besides the existing plant in Avedøre in the greater Copenhagen area where the surplus heat is needed. This new plant can substitute some of the older plants on Zealand leading to lower emissions from the total energy system.

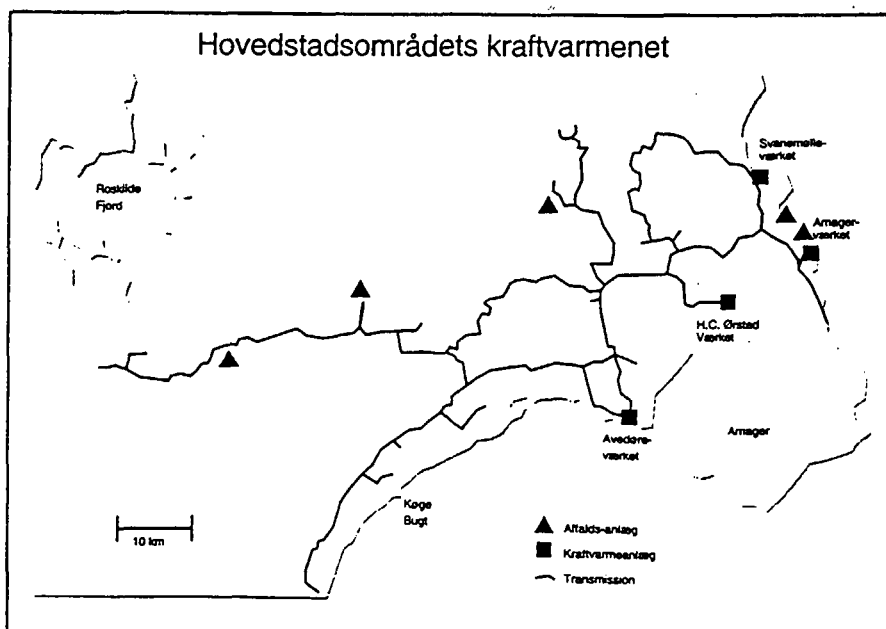
Fuel use and efficiency of plants in the Copenhagen area.

The fuel uses for CHP production consist of coal, natural gas and oil, with coal as the main contributor. The plants in Amager and Avedøre normally use coal as a fuel with oil as reserve fuel while Svanemøllen Power Plant and H.C. Ørsted Power Plant have been retrofitted to use natural gas, again with oil as a reserve fuel.⁵²

The thermal efficiency of the energy system in Copenhagen has been improved drastically as new technologies have emerged and as the CHP production has expanded its share of the total heat production. Between 1960 and the early 1990'ties, the overall efficiency of the production system was improved from 47% to 75% on a yearly basis. Today the two most efficient CHP plants in the Copenhagen area are producing at a thermal efficiency of 93% electricity and heat and 7% loss at moments with maximum heat needs.⁵³ The overall efficiency of the energy system in the greater Copenhagen area is much higher than in the rest of the ELK-RAFT area. This is mainly a result of the high penetration of CHP in the Copenhagen area compared to the other parts of Zealand and due to the use of plants with higher electric efficiencies.

The transmission and distribution system.

Figure 4: The transmission system in the greater Copenhagen Area.



Source: County of Copenhagen, January 1996 (a).

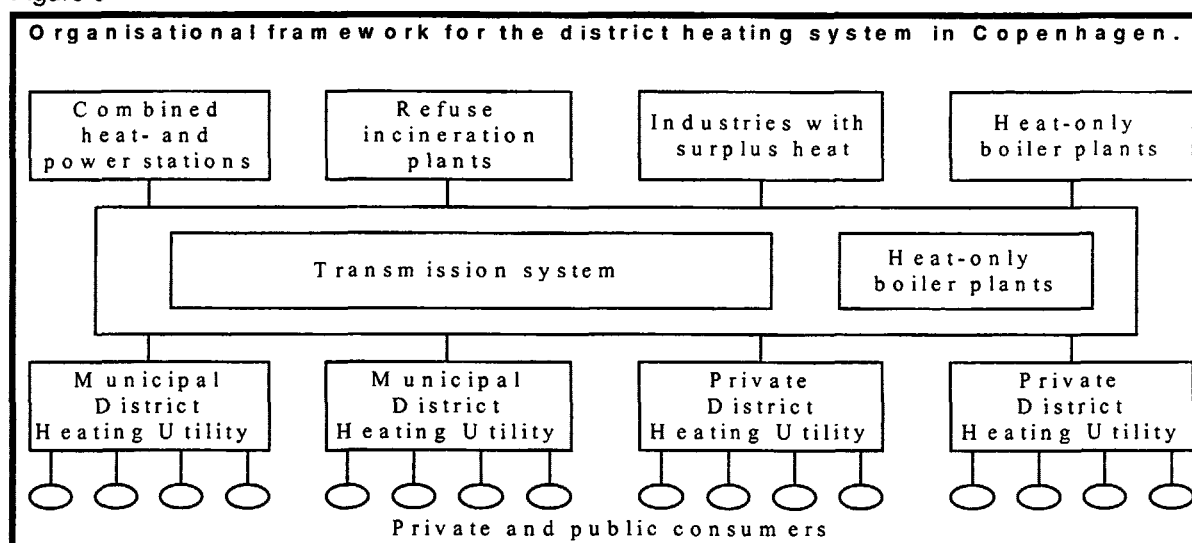
⁵² KB Energy, 1995, p. 15.

⁵³ KB Energy, 1992, p. 133.

In the greater Copenhagen area there are two companies which are responsible for the construction activities and overall operation of the heat transmission system. One part of the transmission system is operated by CTR, the Metropolitan Copenhagen Heat Transmission Company, supplying five municipalities in central Copenhagen. The other part of the transmission system is operated by VEKS Heat Transmission Company supplying 10 municipalities in the west part of the greater Copenhagen area. The two transmission systems operated by CTR and VEKS are interconnected. CTR's and VEKS' transmission systems consist of more than 150 kilometres of district heating lines.⁵⁴

The transmission companies CTR and VEKS buy heat from the production companies connected to the transmission system. This heat is supplemented by heat from the transmission companies' own peak-load and standby plants if necessary. Today approximately 90% of the heat comes from CHP plants while 10% comes from heat-only peak plants⁵⁵. CTR and VEKS sell the heat at purchasing points (heat exchanger stations) to associated local distribution companies and other customers.⁵⁶ These local distribution companies and other customers are responsible for the transportation of heat from the purchasing points to the individual heat consumers. The distribution companies are managing a pipeline system, which is considered to be one of the biggest district heating systems in the world.⁵⁷

Figure 5



Source: Danish Energy Agency, 1993, p. 47.

The district heating system in central Copenhagen consists of two different types, the oldest one is steam based and the newer one is based on water with initial transmission temperatures of 70 - 90 degrees Celsius. The oldest steam based system has not been expanded since 1984 as it has been decided to convert the whole system to a low temperature based system over a period of 10-15 years probably starting up after year 2000. In 1993 the old steam based part of the system covered 40% of the delivered heat in central Copenhagen. The main part of the steam for the old net comes from the two oldest CHP plants in Copenhagen, while the low temperature heat mainly comes from two newer plants.⁵⁸

The demand for low temperature heat in the greater Copenhagen area is expected to grow in the future. The actual growth in demand is uncertain and will depend on the following parameters:

- The growth in the number of new customers.
- The speed of the conversion of the old steam based distribution system to low temperature heat.

⁵⁴ Danish Energy Agency, 1993, p. 26.

⁵⁵ ELKRAFT, 1994 (a), p. 27.

⁵⁶ Danish Energy Agency, 1993, p. 26.

⁵⁷ KB Energy, 1995.

⁵⁸ ELKRAFT, 1994 (a), p. 49.

- The specific heat needs of the buildings in Copenhagen.

Different expectations to these parameters have been subject to disagreements between the authorities, the green organisations and the electric utilities and the heat companies when discussing the need for the plant's heat production.

Chapter 6 - SK Power's applications.

The first application.

In September 1994 SK Power applied for the authorities' authorisation to build a new CHP plant, Avedøre 2, at the Avedøre site in the greater Copenhagen area that was envisaged to start production in year 2000. SK Power's plan to build Avedøre 2 is closely connected to an agreement made between SK Power and the Swedish energy company Vattenfall A/B about future co-owned plants. The proposed plant and the agreement with Vattenfall were therefore presented as a "package" in the application to the authorities.⁵⁹

SK Power's arguments for the need for an agreement with Vattenfall.

The main contents of the agreement between SK Power and Vattenfall is that Vattenfall buys an owner share of 40% in Avedøre 2's electric capacity while SK Power buys an owner share of 800 giga watt hours per year of the hydro power production from Vattenfall's hydro power plants situated at Indalselven in Sweden, by buying 25% of the stocks in the power company Indalskraft A/B. Furthermore Vattenfall gets access to use 200 mega watt capacity on ELKRAFT's KONTEK-sea-cable connection between Zealand and Germany.⁶⁰

SK Power mentions the following arguments for the expediency of the agreement with Vattenfall:

- ELKRAFT gets access to environmentally sound hydro power from Sweden that, according to SK Power, can substitute production on peak-load plants on Zealand. This will secure, that production on the most inefficient plants in the ELKRAFT area can be avoided in a number of situations, leading to a cleaner, cheaper and more efficient production.
- Furthermore, SK Power finds that the company's possibilities to realise co-operation with foreign companies on subjects such as cable connections to other countries, research and development in new technologies and participation in commercial projects in third countries will be strengthened.
- Finally, SK Power states that the Vattenfall agreement will impose a strategic strengthening of ELKRAFT's position on a future open and liberalised market for electricity in EU.

SK Power's arguments for the need for Avedøre 2.

On the grounds of an analysis of the energy system on Zealand the proposer recommended to build the Avedøre 2 plant to fulfil the following goals⁶¹:

- To meet the government's CO₂ emission reduction goal.
- To meet the government's SO and NO_x emission quotas in the ELKRAFT area.
- To modernise the production capacity in the ELKRAFT area.
- To get a higher share of co-produced heat and power in the ELKRAFT area.
- To fulfil the agreement made with the Danish government on the use of biomass.
- To be able to cover the growing need for heating in the Copenhagen area with CHP production.
- To improve ELKRAFT's competitiveness and strengthen international relations.
- To export the multi-fuel concept to other countries by having a highly efficient reference plant in Denmark that can demonstrate the viability of the technology.

SK Power is convinced, that all these goals will be furthered with the installation of Avedøre 2 and the agreement with Vattenfall mentioned above.

In 1994 when SK Power applied for the authorities authorisation they feared, that if the authorities were not ready to approve the construction of Avedøre 2 so that it could start producing in 1999, these goals would not

⁵⁹ SK Power, 22.09.1994.

⁶⁰ SK Power, 22.09.1994.

⁶¹ ELKRAFT, 1994 (a) and SK Power, 22.09.1994.

be fulfilled, and furthermore they were in doubt regarding whether the agreement with Vattenfall could be maintained if Avedøre 2 was not in production at that time. It is also in this perspective that the linking of the Avedøre 2 plant and the Vattenfall agreement should be seen.

The first application was rejected.

The first application from SK Power was turned down by the Danish Energy Agency on behalf of the Minister for Environment and Energy, currently being the Social Democrat Svend Auken. The main criterion for the Danish Energy Agency's rejection of the project was that the proposed plant could not give the environmental benefits needed.⁶² The rejection is described in more detail in Chapter 14.

The second application.

On 11 March 1997 SK Power sent a new application to the Danish Energy Agency asking for a new treatment according to the law on electricity supply. The new application presents a project that is not much different from the first proposal, especially considering the choice of technology for the plant. The decisive difference from the first proposal is the fuel type mix.

The revised application mainly differs from the first application on the following points:

- A new long-term strategy for gas use in the Copenhagen area: The Avedøre 2 plant is now proposed to be mainly natural gas fired as a consequence of the Danish Energy Agency's rejection of Avedøre 2 as a mainly coal fired plant and as a reaction to the Government's decision from February 1997 to stop building coal fired plants. The plant is proposed to be built without coal facilities. Furthermore the proposer intends to use more gas in the region as a whole.
- A new strategy for phasing out old production plants: The old inefficient plants, Stigsnæs 1 and Asnæs 2, which are not equipped with filters for NO_x and SO₂ will be phased out when the production starts up at Avedøre 2.
- A new estimate is made for the future heat needs in the greater Copenhagen area: The heat use has grown in the last two years and is expected to grow more in the future. Therefore ELKRAFT estimate that Avedøre 2 will be necessary in year 2000.
- A new strategy for the long term investment needs in the ELKRAFT area: Many of the power plants in the ELKRAFT area were built at the end of the 1960'ties and in the early 1970'ties. These plants are not updated with environmental technologies like filters etc. As the main part of these old plants is to be phased out within a rather short time frame it is not economical to retrofit them with new environmental technologies. Therefore ELKRAFT has made a plan of phasing out 1000 MW capacity just after year 2000 and additionally 1000 MW in the period before 2010. In this perspective SK Power finds it urgent to start the transition soon by building Avedøre 2.⁶³

The approval of the second application.

The second application was approved by the Danish Energy Agency mainly due to the plant's improved environmental performance due to the use of natural gas in stead of coal as a main fuel.⁶⁴

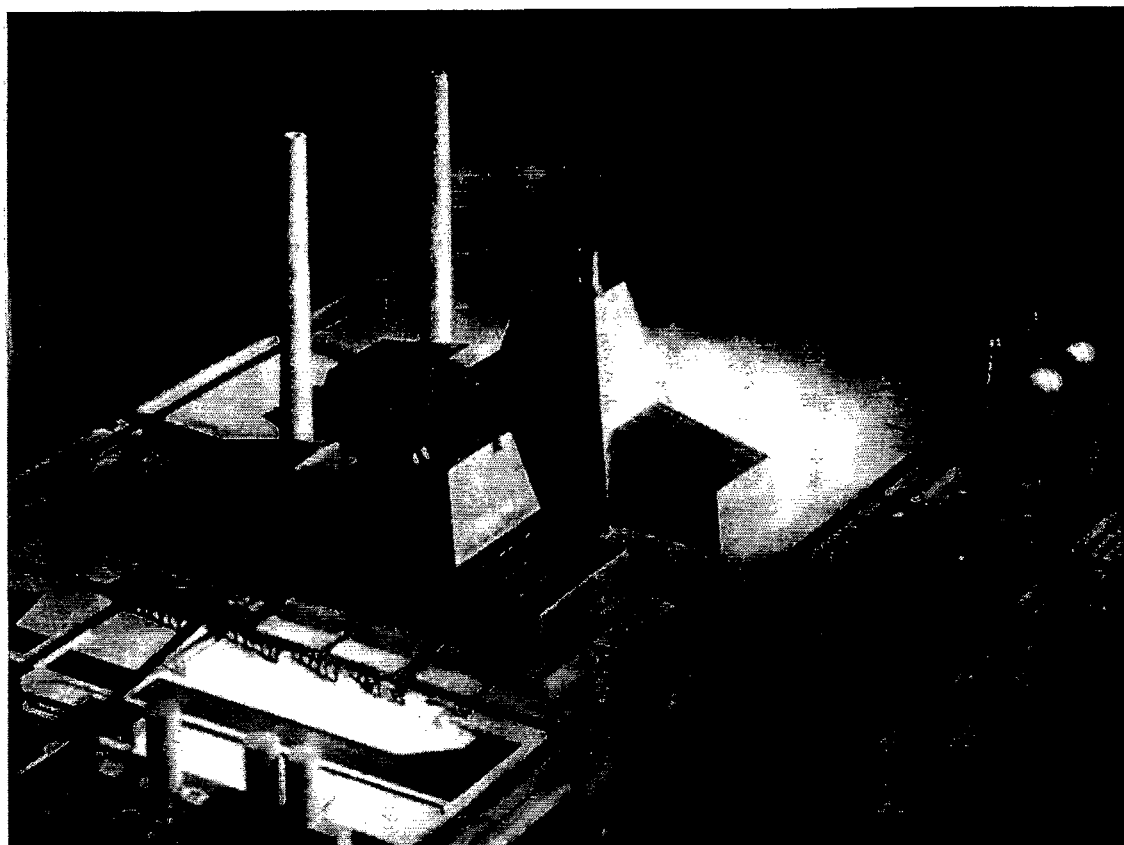
⁶² Danish Ministry for Environment and Energy, 28.06.1996.

⁶³ SK Power, 11.03.1997.

⁶⁴ Danish Energy Agency, 31.03.1997.

Chapter 7 - Data summary for Avedøre 2 and alternatives.

Figure 6: Visual presentation of the Avedøre 1 and Avedøre 2 plants.



Source: ELKRAFT, 1997 (a)

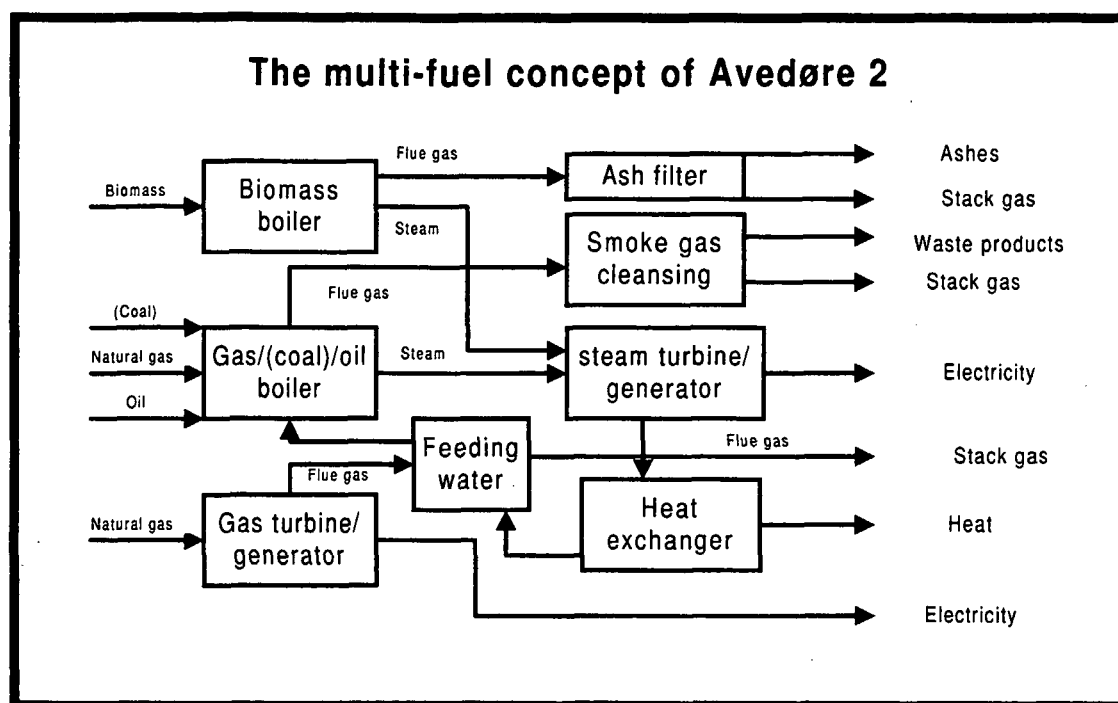
The picture illustrates a visual representation of the Avedøre 2 plant besides (behind) the existing Avedøre 1 plant. As can be seen the new plant will be taller than the old one due to the use of a taller boiler. The plant site is situated on the shore of the bay. The smaller buildings closest to the bay contain the installations for stack air cleaning. The stacks at the top of the roofs of the two tall buildings are for the flue gas from the gas turbine. Situated on the right are two storage tanks for hot water. These are used to store water for district heating at times when the demand is low.

Technical description of the approved Avedøre 2 plant.

The concept for the Avedøre 2 plant is a so called multi-fuel technology for production of CHP. The concept is an innovative technology and will be the first of its kind as well as one of the world's most advanced CHP plants. The multi-fuel technology makes it possible to use a range of different fuels at the same time or separately and to shift between these. Originally it was the proposer's intention that the plant should be able to use coal, fuel oil, natural gas and biomass. However, as the Danish Energy Agency rejected the plans to use coal the plant is not to be equipped with coal burners, but these can be installed later on if that becomes politically acceptable. The plant combines high energy efficiency with use of electrostatic precipitator, desulphurisation and deNO_x installations removing ash, SO₂ and NO_x. Thereby the plant will have lower emissions to the air per unit of energy produced than the older plants in the ELKRAFT area.¹

65 ¹ ELKRAFT, 1995 (c) and SK Power, 1997 (a).

Figure 7: Illustration of the multi-fuel concept.



The main component of the plant is a 325/390⁶⁶ MWe ultra super critical (USC) steam boiler that can be fired by both oil and natural gas. Furthermore there is a 120-150 MWe gas turbine and a 44 MWe biomass boiler, connected to the plant. The USC boiler produces steam that is fed to a steam turbine producing electricity. After having passed the steam turbine the steam is fed to a heat exchanger where the water for district heating is heated by the steam. After having passed the heat exchanger the water is used for feeding the USC boiler again and the cycle is closed. The gas turbine drives a generator that produces electricity. The residual stack gas is used for heating the feeding water for the USC boiler before leaving the plant through the chimney. The biomass boiler produces steam that is fed to the USC steam turbine. The three components together have a higher efficiency than three separate plants would have as they create a synergetic effect: The use of the stack gas from the gas turbine for heating the feeding water for the USC boiler raises the efficiency of the gas turbine. The use of the steam from the biomass boiler in the big steam turbine for the USC boiler gives a higher output of the steam from the biomass boiler than a smaller steam turbine would have given at a separate biomass plant⁶⁷. Generally the Avedøre 2 plant is a highly efficient plant.⁶⁸

The approximate electric efficiencies of the USC boiler and the biomass boiler will be 48,3% and 45% respectively, while the electric efficiency of the gas turbine will be at least 58%. The total electric efficiency of the plant will be approximately 50% with current technology.⁶⁹ SK Power and ELKRAFT expect that the electric efficiency of gas turbines can be raised to 60% in the next generation of turbines. The use of such a new and more advanced gas turbine technology will thereby raise the efficiency of the multi-fuel concept further.⁷⁰

Environmental data for the approved Avedøre 2 plant.

The plant's main environmental impacts stems from emissions to the air. Other types of environmental problems such as emissions of waste and heating water to the bay, emissions from heavy truck traffic and de-

⁶⁶ 390 MW net in condensing mode and 325 MW net in back-pressure mode.

⁶⁷ According to SK Power around 70% higher output per amount of straw than the best existing plant in Denmark.

⁶⁸ ELKRAFT, 1995 (c) and SK Power, 1997 (a).

⁶⁹ ELKRAFT, 1995 (c).

⁷⁰ ELKRAFT, 1996 (a).

positing of solid waste as for example ashes have been assessed by the proposer and the County in the EIS-report. Here we have chosen to focus on emissions to the air.

Emissions to the air.

The emissions to the air from the Avedøre 2 plant will depend on several assumptions such as fuel type mix, fuel quality and effectiveness of stack gas cleaning.

On a yearly basis the proposer intend to use approximately 600 million cubic metres natural gas, 150.000 tonnes biomass and additionally some fuel oil as reserve fuel in the plant. This corresponds to a fuel type mix of approximately 85% natural gas, 10% biomass and 5% fuel oil.⁷¹ 15% of the total fuel use is expected to be used in the gas turbine while 75% is expected to be used in the USC boiler. The maximum gas use possible would be 720 million cubic metres totally, if not using oil at all⁷².

The mainly gas fired Avedøre 2 plant's environmental performance is generally better than the originally proposed coal fired alternative. However the alternative with maximum gas use (90% gas and 10% biomass) would have been even better seen from an environmental point of view.⁷³ Implementation of the mainly gas fired Avedøre 2 plant will reduce the emissions of SO₂, NO_x and CO₂ from ELKRAFT's total energy system by substituting production on some of the older less energy efficient plants on Zealand which are not equipped with filters. According to SK Power's calculations the total emissions of SO₂, NO_x and CO₂ will be reduced by 30%, 20% and almost 10% respectively.⁷⁴ Table 1 gives an example of the emissions per kilowatt-hour of energy produced from the Avedøre 2 plant as compared to one of the oldest coal fired plants which is not situated in an area where the heat can be used for district heating and which is not equipped with installations for desulphurisation or removal of NO_x.

Table 1: Emissions per kWh energy produced by Avedøre 2 plant compared to an old plant.

Emission	Old coal plant without heat use or desulphurisation or deNO _x installations	Avedøre 2
g SO ₂ / kWh	6,7	0,0-0,1
g NO _x / kWh	2,2	0,5-0,6
g CO ₂ / kWh	840	390-400

Source: SK Power, "Avedøre 2", p. 10, 1997 (a).

The Avedøre 2 plant's two boilers and the gas turbine can be fuelled by different fuels. As can be seen in the table below all emissions are lowest when using gas compared to other fuels. The stack gas is not expected to be cleaned for SO₂ when using gas as fuel.

Table 2: Atmospheric emissions (after cleaning of stack gas) per unit energy input.

Emission	Natural gas fired USC plant.	oil-fired USC plant.	Gas turbine.	Straw Boiler.	Coal fired USC plant
SO ₂ (mg/MJ)	0	<100	0	50 - 115	80 -142
NO _x (mg/MJ)	<62	<62	43 - 110	135	40 - 71
Dust** (mg/Nm ³)	~0	<50	~0	50	20 - 50
CO ₂ (g/MJ)	57	78	57	CO ₂ neutral	95
NH ₃ (mg/MJ)	0	0,5-1,3	0	0	0,5-1,3

*Based on oil with sulphur content below 4%. **Dust in dry stack gas with 6% O₂ for coal and 3% O₂ for gas and oil.

Source: SK Power, "Avedøre 2", p. 14, 1997 (a) and County of Copenhagen, Environmental approval", 18.03.1998.

Furthermore there will be fewer ashes per amount of energy produced on Avedøre 2 than from less efficient coal fired plants. However due to the stack filters for SO₂ and NO_x there are some waste products from the Avedøre 2 plant that are not produced at older plants where the substances are emitted to the air. The sul-

⁷¹ SK Power, 1997 (a).

⁷² SK Power, 16.04.1997.

⁷³ SK Power, 16.04.1997.

⁷⁴ SK Power, 1997 (a).

phur and gypsum products are sold for industrial purposes while the ashes from coal are mainly used for land filling and industrial purposes.

ELKRAFT has calculated the emissions of NO_x, SO₂, and CO₂ that is emitted per kilowatt-hour produced in their part of the energy system on average. As seen in the table below the emissions per kilowatt-hour actually increased significantly in 1996 as compared to 1995. This development was due to intensive use of old production plants for exports of electricity. If comparing the emissions per kilowatt-hour adjusted for exports the emissions were reduced. Furthermore estimates for the fuel use and main waste products are given in the table.

Table 3: Environmental declaration for an average kilowatt-hour produced in the ELKRAFT area.

1kWh = 3,6 MJ	1996	1995
Emissions		
CO ₂ g/kWh	535 (476)	484 (511)
SO ₂ g/kWh	1,82 (1,35)	1,75 (1,86)
NO _x g/kWh	1,37 (1,14)	1,23 (1,29)
Fuel use		
Coal g/kWh	161	151
Oil g/kWh	9	9
Natural gas g/kWh	0,02	0,02
Orimulsion g/kWh	42	29
Straw g/kWh	2,7	2,3
Waste products		
Ashes g/kWh	20	21
Gypsum g/kWh	8	7

Data in parenthesis are corrected for imports and exports while the data outside the parenthesis' represents the actual environmental damage.

Source: ELKRAFT, "Energy and environment in east Denmark", 1996 (b).

The first two columns in Table 4 show the expected yearly emissions of SO₂, NO_x and dust from the approved gas fired plant. The information's in Table 2 and Table 4 indicate that especially the sulphur content of the fuel is an important parameter for the emissions of SO₂. The last two columns in Table 4 show the expected yearly emissions from the originally proposed mainly coal fired plant. As can be seen the emissions of SO₂ and dust are far lower for the mainly gas fired plant than for the mainly coal fired version. However the emissions of NO_x are not much lower due to the fact that the stack air is not cleaned when using gas as fuel.

Table 4: The expected yearly emissions of SO₂, NO_x and dust from the plant.

Emission	Approved plant Before cleaning, (tonnes/year)	Approved plant After cleaning, (tonnes/year)	Mainly coal fired plant Before cleaning, (tonnes/year)	Mainly coal fired plant After cleaning, (tonnes/year)
SO ₂	1500 - 5700 (1)	70-285 (1) (2)	13300-28300	1200-2300
NO _x	5200 - 6000	1800 - 2100 (2)	7100	2400
Dust	72	44 (2)	50000-120000	225-400

(1) Depending of the oil's sulphur content (1-4%). Calculated on the basis of 1000 yearly production hours with oil as a fuel.

(2) Assumed 95% cleaning of SO₂. For NO_x max. 65 mg/MJ. Assumed at least 65% cleaning for oil firing. For dust the emissions will be at least 50 mg/Nm³.

Sources: County of Copenhagen, 18.03.1998 and County of Copenhagen, January 1996 (a).

In Table 5 the emissions of heavy metals and chloride from Avedøre 2 before and after cleaning are shown. The emissions are heavily dependent of the type of oil used. Depending on the origin of the fuel oil the emissions will change. For most metals the cleaning is quite effective separating 70 to 80 per cent. For cadmium and nickel only 60 and 65 per cent are separated.

Table 5: Emissions of heavy metals and chloride from Avedøre 2 before and after cleaning.

Heavy metal	Before cleaning (kg/year)	Before cleaning (Kg/year)	After cleaning (Kg/year)	After cleaning (Kg/year)
production hours with oil as fuel	1000 h/year	7000 h/year	1000 h/year	7000 h/year
Arsenic	7,2	50	1,5	11
Cadmium	1,8	13	0,7	4,9
Chromium	6,6	46	2	14
Mercury	0,6	4,2	0,2	1,4
Nickel	925	6475	400	2797
Lead	9,0	63	2,4	17
Chloride	3100	22000	200	1300

Note: Emissions from the biomass boiler are not included.

Source: County of Copenhagen, 18.03.1998

Reduction of CO₂ emissions.

The most important parameter considered has been the plant's contribution to reduce emissions of CO₂ from the energy system. Emissions of CO₂ contribute to the greenhouse effect. The emissions have no local or regional consequences.

The plant's contribution to reduce the emissions of CO₂ from the energy system has been estimated to approximately 1,5 to 1,6 million tonnes per year, corresponding a reduction of Denmark's total emissions of 2,5 per cent. Thereby the plant can contribute significantly to reach the 20 per cent reduction that is to be realised before 2005 as compared to 1988. The reduction of emissions stems from three factors⁷⁵:

1. Use of 600 million m³ gas substituting coal reduces emissions by 0,9 million tonnes.
2. Use of 150.000 tonnes of biomass substituting coal reduces emissions by 0,2 million tonnes.
3. Fuel use in the energy system is reduced by approximately 5 PJ due to the plant's higher efficiency compared to older plants and due to the increase of the CHP share in the Copenhagen area. This reduces emissions by 0,4 to 0,5 million tonnes.

Modelling the concentrations of NO_x and SO₂ and heavy metals in the air near by the plant.

Emissions of NO_x and SO₂ both contribute to regional and local effects. They are harmful for the health of the population as they lead to creation of smog and annoy peoples respiratory passages. Furthermore they both contribute to acid rain and NO_x indirectly contribute to the greenhouse effect and destruction of the ozone layer.

As mentioned in Chapter 4 the utilities' total emissions are regulated by the Danish Energy Agency by quotas. However the environmental damage on the local scale is regulated by putting out limit values for the plant's contribution to the concentrations of NO_x and SO₂ in the air near by the plant. The concentrations in the local area are primarily reduced by installing cleaning equipment and by building tall stacks.

For the EIS-report the concentrations in the local area have been modelled. Results show that if both the Avedøre 1 and the Avedøre 2 plant were coal fired the total concentrations in the local area from the two plants would stay below the limit values for major industries. As can be seen in Appendix 1 and Appendix 2 model results are presented in a map covering the nearest 12 kilometres around the plant. For NO_x the maximum concentration falls in the northern part of the plant area, and is 91% of the limit value corresponding 114 µg/m³. The value for NO_x is probably over-estimated as the calculations are based on the use of a large gas turbine and higher emissions per amount of fuel than what is actually expected. The maximum SO₂ concentration falls 1,5 kilometres north of the plant, and is 28% of the limit value corresponding 71 µg/m³.

After the mainly gas fired plant proposal was approved by the Energy Agency the proposer made some new calculations for the immissions from the Avedøre 1 and the Avedøre 2 plant together.

⁷⁵ Danish Energy Agency, 26.03.1997 (a).

For the approved gas fired plant the emissions of SO₂ are lower than for the coal fired version. Therefore, as seen in Table 6, the total maximum concentration from the Avedøre 1 and the Avedøre 2 plants together are 35 µg/m³ corresponding 14 per cent of the limit value. Furthermore, as seen in Table 7, even in situations where the Avedøre 1 plant is fired with coal with a sulphur content of 2,5 per cent and the Avedøre 2 is fired by oil with a sulphur content of 4 per cent⁷⁶ the maximum concentration will be 59,5 µg/m³ corresponding 24 per cent of the limit value.

Table 6: Immission calculation for SO₂: Avedøre 1 and natural gas fired Avedøre 2 inclusive biomass boiler.

	Unit	AVV1	USC-boiler	Biomass boiler
Fuel		Coal	Natural gas	Straw
Sulphur content	%	2,5	-	0,09
Effectiveness of desulphurisation	%	93		-
Stack height	m	150	150	150
SO ₂ emission	g/s	77,14		11,49
Immission contribution	µg/m ³	34,1		3,3
Total contribution	µg/m ³	36		
Limit value	µg/m ³	250		

Source: County of Copenhagen, 18.03.1998.

Table 7: Immission calculation for SO₂: Avedøre 1 and oil fired Avedøre 2 inclusive biomass boiler.

	Unit	AVV1	USC-boiler	Biomass boiler
Fuel		Coal	Oil	Straw
Sulphur content	%	2,5	4	0,09
Effectiveness of desulphurisation	%	93	95	-
Stack height	m	150	150	150
SO ₂ emission	g/s	77,14	79,7	11,49
Immission contribution	µg/m ³	34,1	28,6	
Total contribution	µg/m ³	59,5		
Limit value	µg/m ³	250		

Source: County of Copenhagen, 18.03.1998.

For NO_x the maximum concentration from the gas turbine will be 114 µg/m³ corresponding 91 per cent of the limit value. The calculations show that the emissions from the tall stack only to a very limited extent fall down in the same area where the emissions from the gas turbine fall. This is due to the gas turbine's lower stack height. The County expects that gas turbines with essentially lower emissions of NO_x than assumed in the calculations will be used by the proposer. Thereby the immission contribution from the gas turbines are also expected to be lowered considerably in the final concept. If the proposer does not use better turbines the immission value is very close to the limit value.

Table 8: Immission calculation for NO₂: Avedøre 1 and Avedøre 2 inclusive gas turbine and biomass boiler.

	Unit	AVV1	USC-boiler	Biomass boiler	Gas turbine
Fuel		Coal	Oil/gas	Straw	Gas
Effectiveness of deNO _x plant	%	80	>65/0	0	0
Stack height	m	150	150	150	95
NO _x emission	g/s	29	52/50	13,5	35,3
Immission contribution	µg/m ³	6,41	10,4/9,2		113,82
Total contribution	µg/m ³	113,82			
Limit value	µg/m ³	125			

Source: County of Copenhagen, 18.03.1998.

⁷⁶ Oil with a sulphur content of 4 per cent is the maximum that the proposer is allowed to use.

Table 9 shows that the two plants' total contribution to the concentration of heavy metals in the air is well below the limit values. The calculation is based on a situation where the Avedøre 1 plant is fired by coal and the Avedøre 2 plant is fired by oil, and the filters function adequately.

Table 9: Immission calculation for heavy metals: Avedøre 1 and Avedøre 2.

Heavy metal	Total immission contribution $\mu\text{g}/\text{m}^3$	Limit value $\mu\text{g}/\text{m}^3$
Arsenic	0,0002	0,01
Cadmium	0,0001	0,01
Chromium	0,0004	1,00
Mercury	0,0002	0,4
Nickel	0,038	0,1
Lead	0,0011	0,4

Note: Emissions from the biomass boiler are not included.

Source: County of Copenhagen, 18.03.1998

Finally the proposer's estimate for the emissions of dust from the two plants is $10 \mu\text{g}/\text{m}^3$. The limit value is $80 \mu\text{g}/\text{m}^3$.

Alternatives considered by the proposer.

The proposer's obligation to compare their own project proposal to alternatives is constituted in the Danish law on planning⁷⁷ and in the law on energy supply and integrated resource management⁷⁸. The law on planning implements a directive from the European Council on evaluation of the environmental effects of major constructions⁷⁹. Therefore the proposer has made a comparison of the originally proposed mainly coal fired Avedøre 2 plant with other solutions, considering:

- Other production technologies.
- The status quo solution (i.e. what will happen if Avedøre 2 is not built).
- Delaying the implementation of Avedøre 2.⁸⁰

The proposer's evaluation is based on a system analysis of the whole ELKRAFT production and supply system without Avedøre 2, with Avedøre 2 in production from year 2000 and with other production technologies from today and until year 2015. The different alternatives considered in the proposer's comparison are:

1. Avedøre 2 with maximum coal firing: 10% biomass, 10-15% natural gas and 75-80% coal.
2. Avedøre 2 with maximum natural gas firing: 10% biomass and 90% natural gas.
3. Avedøre 2 fired with natural gas in the summertime: 10% biomass, 45-50% natural gas and 40-45% coal.
4. A 470 MW natural gas fired combined cycle plant.
5. A 200 MW natural gas fired combined cycle plant.
6. Avedøre 2 without coal facilities for natural gas firing.
7. Avedøre 2 is postponed for 5 years to 2005.
8. New coupled gas turbines at the existing plants H.C. Ørsted plant, Amager 3 plant and Avedøre 1 plant in year 2000 and the Avedøre 2 plant producing from year 2006.
9. Production from a range of small decentralised natural gas fired CHP plants in the greater Copenhagen area with a total electric capacity of 330 MW producing from year 2000.
10. The status quo solution where no additional new major plants are built.⁸¹

As for the alternatives where Avedøre 2 is not built, SK Power has based the calculations on the assumption that they will not have access to 200 MW of Vattenfall's hydro power capacity. This assumption of course leads to a disadvantage on the behalf of the economical and environmental competitiveness of the alterna-

⁷⁷ Law on Planning, 30.06.1997.

⁷⁸ Law on amendment of the Law on electricity supply (integrated resource management), 09.02.1994.

⁷⁹ Danish Ministry for Environment and Energy, 1995 (a).

⁸⁰ ELKRAFT, 1995 (d).

⁸¹ ELKRAFT, 1995 (d).

tives.⁸² The subsequent development has shown, that SK Power has been able to buy hydro power capacity even though the plant has been rejected by the authorities. Thereby the calculations are favouring the Avedøre 2 solution on this point.⁸³

The assumptions behind the comparisons.

The assumptions used by the proposer when calculating the effects of the different alternatives are of course of crucial importance for the conclusions. It is not possible to describe in detail all the assumptions here, but the main criticism raised in the debate is:

- The biomass use is set to 500.000 tonnes in all alternatives.
- The wind power capacity is set to grow from 140 MW to 300 MW by 2005 in all alternatives.
- The amount of decentralised, local and industrial CHP production is set to grow from 240 MW to 500 MW in all alternatives.
- All alternatives besides the status quo fulfil the SO₂ and NO_x quotas. In the alternatives where this can not be accomplished by only building the alternatives and phasing out old plants it is assumed that stack filters are implemented on some of the old plants.
- All alternatives are based on assumptions of electricity savings in the future.
- All alternatives are based on assumptions of substantial growth in heat use in the future. The heat prognosis is developed in co-operation with KB Energy and the transmission companies CTR and VEKS. It is assumed in the heat prognosis that the old steam based distribution system is converted to low temperature heat during the period 2000-2015.
- The possibility to save heat in the greater Copenhagen area has been evaluated, as the Danish Energy Agency has commissioned a report on the costs of heat savings from the Danish Technological Institute. This report concludes that heat savings are much too expensive to be able to compete with the Avedøre 2 solution.⁸⁴

The proposer's comparison of alternatives.

For each alternative has been calculated the fuel type mix, fuel use, emissions, economy and CHP share. Additionally the proposer has evaluated the alternatives' impacts on security of supply, competitiveness and employment.

Fuel use.

In all alternatives the use of coal in the ELKRAFT area will be reduced and the use of gas, biomass and wind power will grow, this is true even for the maximum coal alternative.⁸⁵

Emissions of CO₂, SO₂ and NO_x.

In all alternatives it will be necessary to establish SO₂ filters on at least one of the old plants to fulfil the quotas in the ELKRAFT area. However, considering the alternatives 5, 7 and 8 listed above it will be necessary to establish more SO₂ removal facilities to fulfil the quotas and for the alternatives 5, 7 and 8 additional deNO_x facilities are needed. The cost of establishing the additional facilities is therefore added to the costs of these alternatives.

The CO₂-emissions will be reduced in all alternatives, even for the status quo solution, as there is an assumed growth in decentralised CHP, wind power and use of biomass in all alternatives. The reduction of the emissions of CO₂ in 2005 compared to 1988 for the different solutions can be seen from the table below. These reductions should be compared to the government's CO₂ reduction goal for the energy consuming

⁸² ELKRAFT, 1995 (d), p. 2-10.

⁸³ ELKRAFT, 1995 (d).

⁸⁴ ELKRAFT, 1995 (d), p. 3-16.

⁸⁵ ELKRAFT, 1995 (d).

sectors which is 20% in 2005. As described earlier, the electricity sector is expected to contribute more than the other energy consuming sectors. As can be seen from the table, the emissions will be lowest concerning the gas fired alternatives.

Table 10: Reduction of CO₂ emissions and emissions of SO₂ and NO_x in 2005 compared to 1988 in the ELKRAFT area.

Alternative:	CO ₂ : Without CHP advantage ⁵ (%)	CO ₂ : With CHP advantage ⁵ (%)	SO ₂ 2000 (1000 tonnes)	SO ₂ 2005 (1000 tonnes)	NO _x 2000 (1000 tonnes)	NO _x 2005 (1000 tonnes)
Avedøre 2 with max. coal ¹	23-24	34-35	23,5	16,7	22,1	17,4
Avedøre 2 with max. gas ¹	29-30	39-40	21,8	16,7	22,6	17,8
Avedøre 2 with gas in the summertime ¹	26-28	37-38	22,6	15,8	22,1	17,4
470 MW combined cycle ²	31	40	20,6	13,2-20,7	21,6	15,7-21,4
200 MW combined cycle ³	25	35	24	16,2-16,4	22,1	16,9-17,6
Avedøre 2 delayed to 2005	20	31	24	16,1	18,8	14,8
Avedøre 2 delayed to 2005 and coupled gas turbines at existing plants	23	33	23,1	15,4	23,5	18
Decentralised gas powered plants	27	37	24	16,1	21,8	16,8
Avedøre 2 without coal technologies (gas, oil and biomass fired)	29	39	20,3	14	22,6	17,8
The status quo alternative ⁴	16	24	32,2	-	28,9	-
ELKRAFT's goal for CO ₂ reduction in 2005	22					
Quotas for SO ₂ and NO _x			24		25	

¹ The two different values are representing respectively a small and a large gas turbine at Avedøre 2

² Three different versions of a 470MW combined cycle has been made.

³ Two different versions of a 200MW combined cycle has been made.

⁴ The reduction of CO₂-emissions in the status quo alternative are generated by the assumed growth in decentralised CHP, wind power and use of biomass which are assumed in all alternatives. No new major plants are considered in this alternative.

⁵ The column without CHP advantage show how big the reductions in CO₂-emissions will be if the savings in the heating sector due to shift to heat from CHP production from other sources is not considered. The other column show the proposer's estimate of the CO₂ reductions if the fuel savings for heat production are considered.

Sources: ELKRAFT, 1995 (d), p. 7 and County of Copenhagen, January 1996 (b), p. 19.

Economical competitiveness.

ELKRAFT has made two kinds of calculations for the economical competitiveness of the alternatives on a 15 year basis. The first kind is a calculation of SK Power's expected need for future investments for the different alternatives including the company's own expectation of fuel prices including taxes and subsidies. The second kind is a calculation of the socio economical expenses, i.e. using the Danish Energy Agency's expectations to future fuel prices exclusive taxes and a real interest rate of 5. In both kinds of calculations the Avedøre 2 with maximum coal use is the cheapest solution due to the low coal price compared to gas, this is true even though a coal fired plant is the most expensive to build.⁸⁶

The gas price is not commercial. However, the proposer mentions that gas might possibly be cheaper in the summertime when demand is low. In such situations the marginal expenses for gas powered production on Avedøre 2 will only be 5% more expensive than coal based production.⁸⁷

Hydro power from Vattenfall can be bought very cheaply compared to the Danish production prices. ELKRAFT has calculated the marginal price to be more than 35% cheaper than the marginal price for coal based electricity production on Avedøre 2. The cheapest of the other solutions are a large combined cycle gas fired plant and the Avedøre 2 USC boiler for natural gas without coal technology. These solutions are estimated to

⁸⁶ ELKRAFT, 1995 (d), p. 35-38.

⁸⁷ ELKRAFT, 1995 (d), p. 41.

cost 1 thousand million (DKr) more in a 15 year period. The decentralised alternative is estimated to be 2,6 thousand million (DKr) more expensive than the original Avedøre 2 multi-fuel concept fired with mainly coal.⁸⁸

Table 11: Expenses for delivered electricity and heat including fuel taxes in fuel expenses. Calculated in 1995 prices for the whole period 1996-2015 according to ELKRAFT's model (billion Dkr.).

	Fuel	Tax/ subsidy	Operation	Plant investment	Total
Avedøre 2 with max. coal	29	5,7	16	6,3	57
Avedøre 2 with max. gas	+1,4	-0,7	-0,2	0	+0,5
Avedøre 2 with gas in the summertime	+0,3	0	-0,1	0	+0,2
470 MW combined cycle	+3,9	-0,7	-0,7	-1,5	+1
200 MW combined cycle	+4,0	+0,2	-0,5	-1	+2,7
Avedøre 2 delayed to 2005	+1,2	+0,3	0	-0,4	+1,1
Avedøre 2 delayed to 2005 and coupled gas turbines at existing plants	+1,5	0	-0,2	-0,1	+1,2
Decentralised gas powered plants	+5,3	-2,0	-0,4	-0,3	+2,6
Avedøre 2 without coal technologies (gas, oil and biomass fired)	+3,2	-1,2	-0,6	-0,6	+0,8

Source: ELKRAFT, 1995 (d), p 35.

Table 12: Expenses for delivered electricity and heat excluding fuel taxes in fuel expenses. Calculated in 1995 prices for the whole period 1996-2015 (billion Dkr), using the Energy Agency's model.

	Fuel	Tax/ subsidy	Operation	Plant investment	Total
Avedøre 2 with max. coal	28,9	-	16	6,3	51,2
Avedøre 2 with max. gas	+1,6	-	-0,2	0	+1,4
Avedøre 2 with gas in the summertime	+0,4	-	-0,1	0	+0,3
470 MW combined cycle	+3,4	-	-0,7	-1,5	+1,2
200 MW combined cycle	+3,7	-	-0,5	-1	+2,2
Avedøre 2 delayed to 2005	+1,3	-	0	-0,4	+0,9
Avedøre 2 delayed to 2005 and coupled gas turbines at existing plants	+1,5	-	-0,2	-0,1	+1,2
Decentralised gas powered plants	+3,0	-	-0,4	-0,3	+2,3
Avedøre 2 without coal technologies (gas, oil and biomass fired)	+3,3	-	-0,6	-0,6	+2,1

Source: ELKRAFT, 1995 (d), p. 37.

The proposer claims that the Vattenfall agreement is tied closely to the implementation of Avedøre 2. The proposer's production price estimates for different alternatives have been major subjects in the public debate of the project and in the Danish Energy Agency's evaluation of the project.

The proposer consider the employment effect of building Avedøre 2 as a multi-fuelled concept to be bigger than for a major combined cycle plant, because the multi-fuel concept is more expensive to build, and because a higher share of the investments is spent on tasks carried out locally and for Danish components. Furthermore the proposer has expectations to the potential to export the multi-fuel concept to other countries leading to more employment in Denmark later.⁸⁹

⁸⁸ ELKRAFT, 1995 (d), p. 35.

⁸⁹ ELKRAFT, 1995 (d), p. 6-9.

Chapter 8 - Environmental approval of power plants in Denmark.

Environmental protection in Denmark.

In the beginning of the 1970'ties the Danish law on environmental protection was established. The law came as a reaction to the growing acceptance that a stronger regulation of the industrial sector's environmental performance was needed. The law ensures that proposers of major production facilities, like for instance power plants, have to apply for the authorities to give an environmental permission before building the plant. At first the law was mainly aimed at reducing local environmental problems. Through the 1970'ties the law mainly contributed to fulfil a dilution policy, i.e. the technical solutions chosen were mainly of the "end-of-line and end-of-pipe" types like for instance taller stacks. In the 1980'ties attention moved from the dilution policy to a new type of "end-of-line/pipe" policy, the so called filter solutions, i.e. the technical solution was mainly to separate harmful substances from the stack air in filters. Of course this strategy has lead to new types of environmental problems, as the air pollution problem has been turned into a waste problem.

The authorities' environmental protection policy was in the beginning mainly aimed at weighing economical and environmental considerations, as these factors were often considered to be opposed to each other. The weighing between economical and environmental concerns was implemented into the environmental policy by putting out emission quotas and immission limits that should secure a certain quality of the recipients. Later on health assessments has played a bigger role when deciding upon the threshold values. The expedient quality of the recipients, i.e. the immission quotas are decided at the national level, i.e. by the Danish Environmental Protection Agency, and used as the major administrative tool by the authorities.

Environmental permissions are given to proposers by the local authorities on the basis of assessments of the proposals' environmental performance as compared to the emission and immission limits put out by the Danish Environmental Protection Agency. The law is actually administrated as a permission law, i.e. a law stating that it is prohibited to pollute unless a permission is given. The authorities' assessments of proposals are elaborated in a process only involving experts at the official level. The public is not involved much.

The growing acceptance of the inadequacy of the "end-of-line/pipe" policy has led to new environmental strategies at the end of the 1980'ties which focus on broader environmental evaluations that considers the respective environmental problems more in connection to each other and in a broader perspective. First of all focus has been expanded from only considering local problems to also assessing regional and global problems. Secondly the problems are seen as interconnected between society's different sectors. Furthermore the need for a more preventive environmental policy has been accepted, i.e. focus has been put more at cleaner technological solutions rather than "end-of-pipe/line" solutions. This newly accepted policy was presented in the government's plan from 1988 for environment and development that put focus on the need to reach a sustainable societal development. This plan was a follow up on the report submitted by the Brundtland Commission in 1987. In the following years the government's plan was followed up by more specific plans for the transport, agricultural and energy sectors (Energy 2000).⁹⁰

Today the authorities' regulation of industrial pollution has been altered to focus more at cleaner technological solutions. However, the law on environmental protection is still mainly administrated as a permission law, where the authorities' main contribution is to establish emission and immission values and to assess whether environmental permissions can be given to industries.

In 1989 the European Community Council's Directive on EIA was implemented into the Danish law on planning. Thereby the permission procedure has been supplemented by the EIA-procedure when giving an environmental permission to major installations like for instance power plants.

⁹⁰ Nielsen, Stefan Krüger, et.al., 1991.

The European Community Council's Directive on EIA.

The main message in the European Community Council's Directive 85/337/EEC⁹¹ from 1985 on EIA of major installations is that the best environmental policy is a preventive environmental protection policy which aim at *"...preventing the creation of pollution or nuisances at source, rather than subsequently trying to counteract their effects..."*. This should be implemented by taking *"...effects on the environment into account at the earliest possible stage in all the technical planning and decision-making processes..."*.⁹²

The main aim of the Directive is to secure that the environmental impacts of major installations are assessed before giving them an environmental permission and a building permit. The EIA should contain an evaluation of the proposed project's impacts on humans and the environment and an assessment of the possibilities to improve the project's environmental performance. Another important aspect of the Directive is that alternatives to the proposed project that have been assessed should be published. Furthermore the project has to be compared to the status quo alternative, i.e. what will happen if the project is not approved. These information's should in principle give the decision-makers a better foundation for their decisions, i.e. a better chance to integrate environmental concerns into their decisions.

However, the Directive also aims at involving the public more in the decision-making process through obligating the authorities to carry through public inquiries where the proposal is published. The public is given the opportunity to state their feelings for the project and to define alternatives. Thereby the decision-making process ought to become more transparent to the public which should in theory have a better possibility to influence the decisions taken.

The procedures for EIA and environmental permissions for major power plants in Denmark.

In 1989 the European Community Council's directive on EIA of major installations was implemented in Denmark as a Government notice⁹³. In 1991 the directive was implemented directly into the Danish law on planning. Major power plants with a thermal capacity which exceeds 120 MW are among the types of projects that are affected by the law.⁹⁴

In Denmark the integration of the EIA-procedure into the law on planning supplements the Danish law on environmental protection from the early 1970'ties. As described above this law ensures, among other things, that proposers of new projects with major environmental impacts will have to apply for an environmental permission by the authorities before building the installations.

In the case of power plants the proposers are therefore obliged to apply for the authorities to carry through both the EIA-procedure and to give an environmental permission to the plant. The regional Counties in which the projects are to be situated are obliged to carry through both procedures according to the laws on planning and environmental protection. However the Minister for Environment and Energy has the authority to call in the County's obligation and let the Ministry for Environment and Energy carry through the procedure as an act of national planning. Such an action can be necessary if the project is considered to be of national interest. Since the Directive on EIA was implemented into the law on planning the authorities have treated two applications to build three major power plants, one of them being the Avedøre 2 project. The Minister has not used his authority to intervene the EIA-procedure in any of these cases. Therefore the Counties have been responsible of the EIA-procedure for major power plants in Denmark.

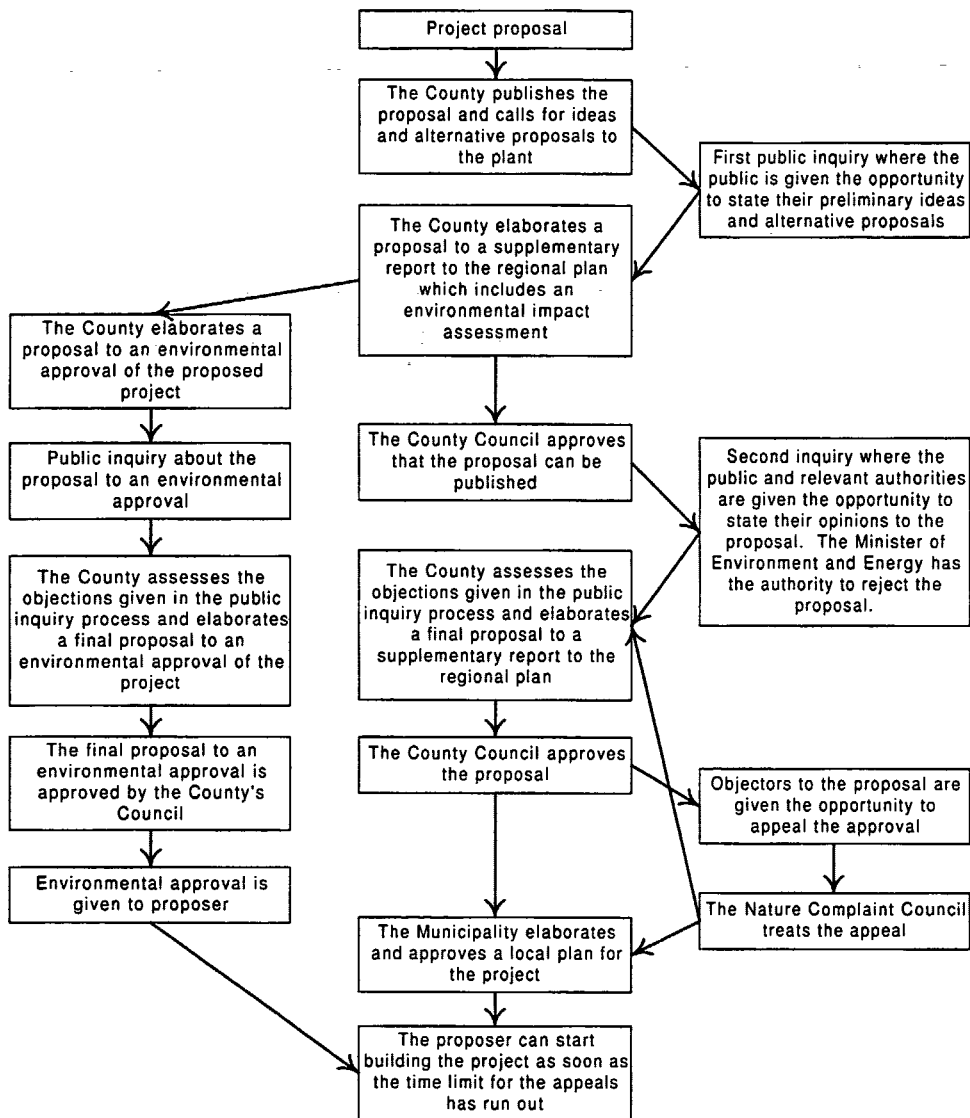
⁹¹ Council Directive, 85/337/EEC, 1985.

⁹² Council Directive, 85/337/EEC, 1985.

⁹³ Government notice no. 446, 23.06.1989.

⁹⁴ Law on Planning, 30.06.1997.

Figure 8: Illustration of a County's typical planning procedure.



When applying for the County to treat a proposal the proposer is obliged to deliver all relevant needed information about the proposed project. The authorities are obliged to decide upon the system borders for the EIA, i.e. which alternatives that should be evaluated and which concrete information that is needed to assess and compare the alternatives.

By giving the counties the obligation to carry out the EIA-procedure the European Council's Directive has been implemented stronger than what was needed. In many other European countries the obligation has been given to the proposer.

Furthermore, the obligation to assess alternatives has also been implemented stronger than what was actually needed. In the Directive it is stated that the EIS-report ought to contain a description of the most essential alternatives that has been assessed by the proposer. In the Danish law on planning it is stated that alternatives that have been assessed should be part of the EIA. This means that the authorities are obliged to include alternatives proposed by other actors than the proposer.

As can be seen from the figure the County is obliged to publish the proposal and call for the public's opinions and alternative proposals at an early stage of the treatment and to arrange public inquiry's. The purpose is

that the public should have the opportunity to have insight in and influence on the treatment of the proposal. The authorities are obliged to evaluate protests or alternatives given by the public in their assessment of the project.

The next step in the County's treatment is to elaborate proposals to an amendment report to the regional plan and to an environmental permission. Both of these proposals should be published and the public again be given the opportunity to comment on the proposals. Among other things the amendment report should contain an environmental impact statement. The EIS-report should contain:

- A description of the project.
- An overview of the main alternatives to the project which have been evaluated and a description of the status quo alternative, i.e. what will happen if the project is not built.
- A description of the project's impact on the population, biology, climate, landscape, architectural and archaeological cultural heritage and the socio-economic impacts of the project's environmental consequences. This description should be accompanied by a description of the plant's visual appearance.
- A description of the project's environmental impacts both in a short and a long term perspective.
- A description of solutions to reduce the environmental impacts of the project, such as use of cleaner technology.
- A non-technical summary of the EIS-report.
- An overview over possible deficiencies in information and the environmental impact assessment.⁹⁵

According to the Ministry for Environment and Energy's guidance on the law on planning the two last points mentioned above are very important as they are often the basis for the decisions taken. Therefore it is essential to explain the evaluations and conclusions and the limitations of those in connection to the environmental problems and the specific type of project assessed.⁹⁶

According to section 3, subsection 4 in the law on planning the Minister for Environment and Energy is authorised to reject the proposal if the project is considered to be of national interest and somehow conflicting with the overall policy. Furthermore he is given the competence to take over the County's legal authority to carry out the EIA-procedure if necessary and the Minister can alter the EIS report or parts of it or take over specific parts of the EIA-procedure.⁹⁷

After the second public inquiry the County again assesses the objections given and elaborates a final proposal to an amendment report to the regional plan and an environmental permission. After these proposals have been approved by the County's Council an environmental permission can be given after the time limit for appeals have run out. However, if any of the objectors to the project chooses to appeal the project to the Danish Appeal Board for Nature Protection the proposer is obliged to await the Appeal Board's decision. The Danish Appeal Board for Nature Protection is only authorised to evaluate whether the authorities have fulfilled their obligations in a legally correct manner, i.e. if the decisions have been taken in the appropriate political forum and by the appropriate legal procedure. The Appeal Board does not have the authority to evaluate the expediency of the decisions taken, even if an appeal is actually grounded in an opponent's political resistance against the project. In cases where the Appeal Board grant an appeal the final amendment report can be disqualified if the Appeal Board estimate that the authorities' treatment has been gravely inadequate seen

⁹⁵ Danish Ministry for Environment and Energy, 1995 (a) and Danish Ministry for Environment and Energy, November 1996.

⁹⁶ Danish Ministry for Environment and Energy, November 1996, p. 60.

⁹⁷ Danish Ministry for Environment and Energy, November 1996, p. 16.

from a legal perspective.⁹⁸ In such a situation the proposer will have to await that the County elaborate a new report which is again sent out in a public inquiry process.

After the environmental permission has been given to the proposer by the County, the local Municipality is obliged to elaborate a local plan for the project. Hereafter the authorities give the building permit.

⁹⁸ Busck, 1995.

Chapter 9 - Earlier power plant treatments.

In this Chapter we give a brief description of the authorities' approval of an earlier power plant proposal in Denmark. A major restructuring of the authorities' treatment appeared when the European Community Council's directive on EIA of major projects was implemented into the Danish laws in the period 1989 to 1991. Since then the Danish utilities have requested the authorities to build two new major power plants besides the Avedøre 2 plant.

The two plants were proposed to be situated in two different counties in west Denmark. They were planned to be built just after each other. The EIA-treatments of the plants were carried out by two different Counties independently of each other. One of the plants was proposed to be gas fired and was therefore approved without significant protests from the public. The other one however, the North Jutland Power Plant, was proposed to be coal fired and was therefore subject to significant negative and long lasting protests from the public, mainly because of the plant's inadequate environmental performance as compared to other alternative solutions.

We have chosen to focus on the authorities' treatment of the North Jutland Power Plant because of the many similarities to the treatment of the Avedøre 2 Plant and because of this treatment's major influence on the authorities' treatment of the proposal to build the Avedøre 2 plant and the public's reactions in the public inquiry process.

Treatment of the North Jutland Power Plant proposal.

Summary of the treatment.

Agreement: In August 1991 ELSAM made an agreement with Poul Nielson, spokesman on energy issues for the Social Democrats' Party and former Danish Minister for Energy about two new major power plants in Jutland, i.e. west Denmark. The Social Democrat agreed to support the implementation of one coal fired plant on the condition that the other plant was to be gas fired. Poul Nielson took the honour that he had convinced the utilities to use gas in one of the plants.⁹⁹

Application: In December 1991 ELSAM applied for the Danish Energy Agency's approval to build two major CHP plants, the North Jutland Power Plant and the Skærbæk Power Plant. Both plants were planned to be of the size of 400MW.

Parliament debate: In March 1992 there was a debate in the Danish Parliament on the need for a renewal of the electricity production system. The debate was a result of ELSAM's application to build the two new major plants. The main issues discussed was whether new production capacity was needed and which types of production technologies and fuels that ought to be used. All political parties in the Parliament still agreed upon the goal put out in the energy plan Energy 2000 to reduce the emissions of CO₂ by 20% before 2005. A majority in the Parliament, consisting of the Social Democrats, the Conservatives, the Liberals, the Christians, and the right wing Progressive Party agreed that the two proposed plants would not hinder the CO₂ reduction scheme. A minority consisting of the Socialists and the Social-Liberals proposed to try to save more electricity and to temporarily stop building centralised plants.

⁹⁹ Danish Parliament, 10.03.1992.

The debate was mainly concentrated on the following problems:

- If it would be possible to save more electricity than proposed by ELSAM. ELSAM's application to build the plants was based on a prognosis for growth in the use of electricity of 30% in the 1990'ties. The planned development in the energy plan Energy 2000 was based on a growth of only 15%.
- If it would be preferable to continue building new coal fired plants or if it would be better to use gas and renewables and stop building any more coal fired plants.
- If it would be better to continue building more decentralised gas fuelled CHP plants in stead of centralised ones. The development in decentralised CHP had not yet reached the energy plan's planned development.
- If it would be a good idea to build production facilities to be able to export electricity to East Europe or if it would be a better idea if the electricity was produced locally in those countries.
- If a sea cable between east and west Denmark could eliminate the need for the two plants.
- If it would be better to retrofit old plants than building new ones, i.e. by adding cleaning technologies for NO_x and SO₂.

In the years before this debate the Social Democrats' Party together with the Socialists and the Social-Liberals had formed a so called green majority in the Parliament. This green majority had secured a fast development in decentralised gas fired plants since the late 1980'ties. However a new political situation appeared after Poul Nielson's agreement with ELSAM. Even though the Social Democrats' Party was openly divided on the question whether there ought to be built any more major coal fired plants in Denmark, the Party's Executive Committee had already given their approval of both the gas fired and the coal fired plant to the government.

The debate in the Parliament led to the approval of a motivated agenda which was an indirect approval from a majority in the Parliament to build the plants on the condition that ELSAM agreed on the obligation to fulfil the CO₂ reduction scheme. Thereby the Parliament had actually already decided upon fuel use, size and siting for the plants before the EIA-procedure was even started.¹⁰⁰

Approval by the DEA:

In April 1992 the proposed plants were approved by the Danish Energy Agency. Similarly to the decision taken by the Parliament this approval was given even before the EIA-procedure was even started.

The approval was based on ELSAM's prognosis for future use of electricity. The need for new production capacity was also partly based upon the assumption that production on some of the older plants was to be stopped (not scrapped), that the implementation of decentralised CHP plants was further developed and that the utilities would export part of their production. Some of the heat from the plants was needed, but the approval was mainly given to renew the electricity production system.

The approval of the plants was given on the condition that ELSAM agreed

¹⁰⁰ Danish Parliament, 10.03.1992.

upon the obligation to reach the CO₂ reduction scheme by shifting fuels from coal to gas and biomass. However, ELSAM was not given any claims to shot down or scrap old production facilities, even though this had been one of the assumptions behind the approval.¹⁰¹

The subsequent development has shown that ELSAM has not shot down as much capacity as has been built. Furthermore there has been bigger growth in decentralised plants and wind turbines and a more modest growth in the demand for electricity than expected by ELSAM. Therefore ELSAM has a large over capacity today.¹⁰²

Public inquiry:

In July 1992 the County of North Jutland published the proposal and called for ideas and alternative proposals to the plant.

EIS-report:

October 1992: After the public inquiry the County made a proposal to an amendment to the regional plan, which among other things contained an environmental impact statement report. The EIS-report evaluated the environmental impacts of the plant, such as visual impacts, noise, air pollution, waste water, cooling water, residuals and waste products.

In the proposal the County stated that the County's Council had not found it necessary to evaluate the alternative proposals to the plant that had been formulated in the public inquiry process. The County felt that as the overall national energy policy, i.e. the Danish Energy Agency's decision to approve the plant, had already been stated, the County would not need to evaluate any alternatives to the plant. Therefore the environmental impact statement did not contain an environmental comparison of the plant with different alternatives.¹⁰³

Appeal:

December 1992: The Energy Group at the University of Ålborg and others complained the County's treatment to the Danish Appeal Board for Nature Protection. The complainers felt that the authorities' treatment of the power plant case had not been carried through correctly according to the law on planning. They felt that the environmental impact statement did not contain sufficient material on the following points, which were actually needed according to the law on planning:

- No alternatives to the central plant had been evaluated even though many alternatives had been proposed in the public inquiry process.
- No other sites for the plant or alternative types of technologies for electricity production or savings had been considered.
- The possibility to use cleaner technologies had not been assessed.
- The impacts of the plant were not evaluated in a more broad sense, i.e. by also assessing impacts of cable connections through North Jutland that, according to the distributor, were needed for the new plant.
- The Danish Energy Agency had already approved the plant before the EIA was carried through. Thereby the European Council's Directive on EIA of major installations had not been observed.¹⁰⁴

¹⁰¹ Danish Energy Agency, 03.04.1992.

¹⁰² Lund, January 1994.

¹⁰³ Danish Appeal Board for Nature Protection, 14.09.1993.

¹⁰⁴ Lund, 18.12.1992.

Comments by:

- EU Commission:** The European Commissions General Directorate XI stated that an environmental impact statement for the cables would probably be necessary.¹⁰⁵
- Environmental Agency:** The Danish Environmental Protection Agency stated that the possibility to use cleaner technology could not be included in the environmental impact statement.¹⁰⁶
- I/S NEFO:** I/S NEFO, a transmission company, stated that the cables were needed anyway, even if the North Jutland Power Plant was not built. Therefore the company felt that it should not only be assessed in connection to the plant.¹⁰⁷
- The County:** The County's answers to the appeal from the Energy Group were as follows¹⁰⁸:
- The County did not feel that they had the competence to evaluate alternatives to the plant, as the specific proposed plant had already been approved both by the Parliament and the Danish Energy Agency.
 - The County did not feel that they had the competence to evaluate alternative sites, as the plant had been approved on the specific site both by the Parliament and the Danish Energy Agency.
 - The County promised that the question of using cleaner technology would be dealt with later on in the County's treatment, i.e. when giving the plant an environmental permission.
 - The County rejected that it should be necessary to include the cable connections in the environmental impact statement report.
- Approval by the County:** April 1993: The County of North Jutland approved the amendment to the regional plan describing how the North Jutland Power Plant could be fitted into the overall regional plan for the area.
- Decision from the Danish Appeal Board for Nature Protection:** September 1993: The Danish Appeal Board for Nature Protection treated the appeal from the Energy Group. The Appeal Board's conclusions were as follows:
- The environmental impact statement ought to have included an evaluation of alternative technologies and sites and compared these to the proposed plant, i.e. the County was obliged to evaluate the alternatives proposed in the public inquiry process.
 - The environmental impact statement ought to have included an evaluation of the impacts of the cable from the plant, but not in it's full length, as the need for the whole cable can not solely be seen as a consequence of the North Jutland Power Plant.
- A majority of the members of the Danish Appeal Board for Nature Protection stated that the County's amendment to the regional plan was invalid because of the inadequate treatment.¹⁰⁹
- New regional plan:** In December 1993 the County of North Jutland had elaborated a new

¹⁰⁵ DG XI, 06.01.1993.

¹⁰⁶ Danish Appeal Board for Nature Protection, 14.09.1993.

¹⁰⁷ Danish Appeal Board for Nature Protection, 14.09.1993.

¹⁰⁸ County of North Jutland, 17.02.1993.

¹⁰⁹ Danish Appeal Board for Nature Protection, 14.09.1993.

amendment to the regional plan describing how the North Jutland Power Plant could be fitted into the overall regional plan for the area. The County had been forced to redo this work as a consequence of the Danish Appeal Board for Nature Protection's rejection of the first plan. In the new plan the County had, among other things, included a description of the alternatives given by the public. This new amendment substituted the first amendment which was approved by the County but stated invalid by the Danish Appeal Board for Nature Protection.

New appeal:

The Energy Group at the University of Ålborg, the Organisation for Preservation of Nature and others complained the County's new amendment to the regional plan to the Danish Appeal Board for Nature Protection. Again these opponents to the plant proposal claimed that the new EIS-report should be rejected because of the County's inadequate treatment. The opponents stated that:

- The County had not carried through an appropriate evaluation of the alternatives proposed by the public in the inquiry process.
- The County had based its evaluation solely on the information's given by the proposer. For example the prognosis for future energy demand is claimed to be obsolete and out of date with the government's official energy policy.
- The cable connections should have been evaluated in their whole length in an environmental impact statement and not just the 300 metres assessed in the County's evaluation.¹¹⁰

County's comments:

The County stated that it was beyond its authority to decide upon overall Danish energy policy matters, such as:

- Need for the plant.
- Alternatives situated outside the County's geographical borders.
- Alternative technologies to the plant, i.e. decentralised plants, use of biomass and renewables and electricity and heat savings.
- An EIS-report for the cable connections in their full length.

The County only felt itself obliged to decide upon the main lines for the siting and the elaboration of the plant.¹¹¹

New decision from the Danish Appeal Board for Nature Protection:

The main assumption behind the appeal was that the plant was not needed at all. The Danish Appeal Board for Nature Protection stated that the Appeal Board could not evaluate whether the plant was needed or not according to the overall Danish energy policy. The Appeal Board was only obliged to assess whether the County's amendment to the regional plan fulfilled the directions put out by the law on planning.

- The Appeal Board agreed with the County that the County was not obliged to evaluate alternatives outside the County's geographical borders, even though this might conflict with the intentions behind the European Council's Directive on EIA of major installations.
- The Appeal Board stated that there was no evidence that the prognosis for future energy demand given to the County by the proposer were deliberately wrong or misleading. The County's use of the proposer's information was thereby not legally wrong.

¹¹⁰ Danish Appeal Board for Nature Protection, 11.04.1994.

¹¹¹ Danish Appeal Board for Nature Protection, 11.04.1994.

- The Appeal Board stated that the need for the new cable connections could not be seen as a consequence of the new plant. Therefore it was not necessary to make an EIA for the cables in their full length.
- The Appeal Board agreed with the opponents to the plant that the alternative possibility to build decentralised plants should have been evaluated in the EIS-report. However all other alternatives defined by the public had been dealt with sufficiently seen from a legal perspective.

A minority in the Appeal Board, consisting of two members out of eleven, stated that if the decentralised alternative had been evaluated in the environmental impact statement it would have given the public the possibility to assess the expediency of building a large coal fired plant. The minority therefore stated that the County's amendment to the regional plan ought to be disqualified. However the majority of the Appeal Board's members found that the County's decision could not be disqualified because of the political statement given to the County from the Danish Energy Agency and the Parliament that the proposed plant was needed.¹¹²

The main criticism raised in the public debate and lessons learned.

The lessons learned in the EIA-procedure for the North Jutland Power Plant have been of major importance to the decision-making process in connection to the treatment of the proposal to build the Avedøre 2 plant. The lessons learned have altered the way in which the authorities now treat applications from utilities to build major power plants in Denmark and the way the opponents act in the public inquiry process.

Sources of information on the opponents' attitudes towards the North Jutland Power Plant are mainly letters from appealers to the Danish Appeal Board for Nature Protection and a series of reports and articles written by people from the energy group at the University of Aalborg.¹¹³ The energy group is formed by a number of social scientists who are opponents to the development with major power plants and therefore have proposed a series of alternatives. They are in favour of decentralised CHP plants, renewables and efficiency technologies mainly due to their better environmental performance, but also due to employment effect and democratic aspects.

Lessons learned for the overall Danish energy debate.

1. The Energy Agency's approval of the North Jutland Power Plant did not directly oblige the utilities to shut down or scrap old production facilities or to implement electricity or heat savings. They were only obliged to shift fuels to fulfil the CO₂ reduction scheme.

As we will explain in more detail in the following chapters the Energy Agency altered the procedure in connection to the treatment of the proposal to build the Avedøre plant. The approval of the Avedøre 2 plant was given on the condition that the proposer fulfils a range of claims. The proposer is obliged to:

- a: Supervise that the heat demand does not exceed the heat prognosis from the energy plan "Energy 21",
- b: Scrap three old production plants, and
- c: Use a certain amount of natural gas as a minimum.

¹¹² Danish Appeal Board for Nature Protection, 11.04.1994.

¹¹³ Andersen, 18.02.1993, Nielsen, 18.02.1993, Lund, November 1991, Lund, 07.05.1992, Lund, 18.12.1992, Lund, January 1994, Lund, June 1995, Lund, 1995, Lund, 1996 (a), Lund, 1996 (b), Lund, March 1996.

2. The Energy Agency's approval of the plants proposed by ELSAM was not based on the same assumptions as was used in the national energy plan "Energy 2000". First of all the approval was based on ELSAM's prognosis for future demand for electricity which was substantially higher than the prognosis in the national energy plan. Furthermore, according to the energy plan no more major coal fired plants should be built until 2030.

As we will explain in more detail in the following chapters there has also been inconsistency between the proposer's and the Energy Agency's prognosis for future heat demand in connection to the treatment of the Avedøre 2 plant. The proposer estimated a steeper growth than the Energy Agency. However this time the Energy Agency did not base the rejection and the approval on the proposer's prognosis.

3. Opponents to the North Jutland Power Plant proposed to have a general debate on the overall Danish energy policy before evaluating the proposed plant. Such a debate would include a discussion of the expediency of central coal fired plants as compared to other alternatives. The opponents considered the plant to be a major bottleneck hindering a sustainable development of the energy system.

This discussion had actually been an ongoing theme in the Danish debate for several years. Actually the energy plan "Energy 2000" had already been based on the assumption that no more major coal fired plants should be built until 2030. However, no political decisions in the Danish Parliament had directly confirmed this obligation. The newest energy plan "Energy 21" is also based on the assumption that no more major coal fired plants should be built. However this energy plan was not published before after the County had carried out the EIA-procedure for the Avedøre 2 plant. Later on, after the rejection of the coal fired Avedøre 2 plant the Danish government stated that no more coal fired plants ought to be built. Therefore, for the time being, such an overall decision has been taken. However, the opposition in the Danish Parliament will probably not maintain the coal stop if gaining the majority in the Parliament after the next election.

4. The Energy Agency's approval of the North Jutland Power Plant was based on ELSAM's prognosis for future growth in electricity demand. ELSAM's prognosis was partly based on an assumed growth in electricity exports. ELSAM argued that electricity exports to other countries with environmentally less efficient power systems would be a good idea. The opponents criticised ELSAM's intentions to export electricity, as they stated that it would be better to build CHP plants in those countries so that the heat could also be used, leading to an even more clean production.

As we will describe in the following chapters the discussion concerning the Avedøre 2 plant has been aimed more at the possibility to import cheap hydro power from Sweden and the possibility to export the multi-fuel plant concept to other countries leading to a more efficient production there. However, there is no doubt that the proposer also intend to export electricity. The proposer has built sea cable connections to Sweden and Germany as to be able to export electricity. Furthermore an important part of the agreement with Vattenfall is that Vattenfall gets access to 40% of the plant's electricity production. Thereby a large fraction of the production might very well be exported. Some opponents to the Avedøre 2 plant has criticised this strategy claiming that Denmark ought not be exporters of electricity generated by fossil fuels.

5. Some opponents stated that building two plants would lead to over capacity in the production system. The Energy Agency actually stated, in their approval of the plant, that by building both plants there would be some over capacity for a period of time. However, by building the two plants just after each other expenses for construction were expected to be lower. Therefore both plants could be approved. In the last years the utilities in west Denmark have been criticised for having a too large capacity. Furthermore some of the opponents claim that the cost of building the plant earlier than it was actually needed has been more expensive than what was saved as a consequence of building two plants just after each other.

As we will explain later there have been similar discussions whether the Avedøre 2 plant ought to be built a few years before it might actually be needed to accelerate the pace for environmental improvement of the energy production system.

The opponents' main conclusion now is that the decision to approve the North Jutland Power Plant was a failure as the later development has shown that the plant is not needed due to a more modest growth in electricity demand and a higher penetration of decentralised production capacity than expected by ELSAM.

The opponents fear that the utilities will apply for additional new major power plants in the future, as they do not expect the utilities to be able to shift technological course. They furthermore fear that "new" alternative technologies such as decentralised plants, renewables and power and heat savings will not be better represented in the decision-making process in the future. Therefore they suggest that the organisational framework within the Danish power sector should be altered by creating new powerful institutions to represent alternative technologies.

Lessons learned for the EIA-procedure.

1. The North Jutland Power Plant was approved both by the Parliament and by the Danish Energy Agency before the County had even started the EIA-procedure. The opponents stated that this action clearly undermined the possibility to propose alternative technologies or sites. Thereby the democratic aspect of the EIA-procedure was hindered from the beginning, as the alternatives proposed by the public were not examined and could not have influenced the decision already taken.

As we will describe later the Energy Agency and the Parliament altered the decision-making procedure in connection to the treatment of the proposal to build the Avedøre 2 plant. This time they awaited the final EIS-report from the County before deciding finally whether the plant could be approved or not.

2. The Danish Appeal Board for Nature Protection's first decision concerning the EIS-report for the North Jutland Power Plant stated that alternatives proposed by the public ought to be part of the County's evaluation. However the Appeal Board's second decision stated that the County could not be blamed for not assessing alternatives outside the County's regional borders. The fact that the County could not treat these alternatives reveals a weak point in the way the Directive on EIA has been implemented in Denmark. As one main aim of the Directive is that emissions should be avoided, it seems evident to evaluate possibilities to reduce emissions, either by using decentralised CHP, using gas or renewable energies as "fuel" or by improving the energy efficiency. The County was not able to evaluate these alternatives, as that would have required an assessment of the total energy system, i.e. as energy saving technologies which could substitute the need for the new plant would possibly be spread out all over the country.

The County was criticised for not being able to evaluate these alternatives to the North Jutland Power Plant adequately. The Minister for Energy who was in office at that time did not call in the EIA-procedure to the Ministry even though she had the authority to do so according to the law on planning. Some opponents state that it would have been better if the Departments of Energy and Environment had co-operated about the tasks to evaluate alternatives and to elaborate the EIS-report or if a group of independent experts had been entrusted the tasks.

As we will explain in the following chapters exactly the same problems arised with the EIA-procedure for the Avedøre 2 plant. Before the County started the EIA-procedure the opponents feared that the County would be unable to evaluate the alternatives proposed by the public in the inquiry process. Therefore they urged the Minister to call in the EIA-procedure to the Ministry. The Minister rejected the request, and the opponents' fears were later justified as the County did not feel obliged to evaluate alternatives outside the County's geographical borders. Therefore, the environmental impact statement for the Avedøre 2 plant became insufficient because of the exclusion of alternatives of significant importance.

3. Opponents felt that the main theme for discussion in the EIA-procedure for the North Jutland Power Plant was moved from the important question of which energy development that would be expedient to a discussion:
- a) Whether the opponents were authorised to appeal the decisions taken,
 - b) Whether the arguments used by the opponents were of a kind that could be treated by the Danish Appeal Board for Nature Protection, and
 - c) Whether the authorities were obliged to treat the alternative proposals or not.

The opponents stated that if the alternatives defined by the public are not assessed in EIA's in the future the EIA-procedure has no real value besides slowing down the decision-making process.

As described in Chapter 7 many different alternatives to the Avedøre 2 plant were evaluated by the proposer on the request of the Danish Energy Agency. However, as we will describe in the following chapters, the most important alternatives proposed by objectors in the public inquiry were still not evaluated thoroughly.

The opponents' main conclusion is that the EIA-procedure for the North Jutland Power Plant did not succeed on giving the public the possibility to have alternative proposals evaluated and compared to the original proposal. The Energy Group today state that if this procedure is not changed the EIA-procedure is reduced to a troublesome piece of work focusing more on the County's geographical borders than on assessing alternatives.¹¹⁴

¹¹⁴ Lund June 1995.

Chapter 10 - Identification of key players and issues.

In this Chapter we introduce the regulatory and political framework for the approval of the Avedøre 2 plant in Denmark. We identify the key players which have been involved in the decision-making process and explain their roles in the process and the key issues discussed concerning the plant.

The authorities' treatment.

The formal planning procedure started when the Avedøre 2 plant and the connected agreement with Vattenfall were approved by the City Council of Copenhagen and ELKRAFT's and SK Power's boards of directors. Hereafter SK Power sent in their first application to the authorities. The treatment of SK Power's application was carried out by authorities at three different levels: The Danish Energy Agency, the County of Copenhagen and the Municipality of Hvidovre.

The Danish Energy Agency and the Minister for Environment and Energy, currently being the Social Democrat Svend Auken, are responsible of approving major electricity plants according to the law on electricity supply. In principle the Minister for Environment and Energy is responsible for approving or rejecting electric utility applications for new plants. Nevertheless, in reality the Minister will need support by a political majority in the Danish parliament when decisions such as giving a rejection or approval to build a major plant like Avedøre 2 is in question¹¹⁵. The first application to build a mainly coal fired plant was rejected because the plant's environmental performance was insufficient as compared to a gas fired plant. SK Power chose to appeal the decision to the Ministry for Environment and Energy. However the Ministry rejected the appeal. Therefore SK Power sent in a new application to build a mainly gas fired plant. The gas fired plant was approved by the Danish Energy Agency and the Minister for Environment and Energy according to the law on electricity supply.

The County of Copenhagen is responsible for the regional planning in the area where SK Power wants to build Avedøre 2. The County was obliged to carry out a regional planning procedure with the purpose of deciding whether the Avedøre 2 Plant could be allowed to fit into the overall plan for the region. The concrete tasks carried out by the County were:

- Two public inquiry's where all interested actors were invited to state their feelings for the Avedøre 2 project and to define alternatives.
- Elaboration of an amendment report to the County's regional plan with integrated environmental impact statement¹¹⁶.
- The obligation to decide whether or not to give the plant an environmental permission, according to the Danish law on environmental protection.

The County of Copenhagen's evaluation of the originally proposed plant and all the alternatives that had been defined by the Danish Energy Agency and the proposer led the County to the conclusion that all the alternatives could be given an environmental permission.

The Municipality of Hvidovre is responsible for the local planning in the area where SK Power wants to build Avedøre 2. The Municipality denies to elaborate a local plan for the plant as the Municipality does not want to have another major plant situated within the municipality's borders. Therefore the Municipality has not yet carried out the inquiry process in the local community. The lack of action in the Municipality on this point has forced the Minister for Environment and Energy to call in the local planning procedure from the Municipality to the Ministry for Environment and Energy's National Planning Department.

¹¹⁵ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

¹¹⁶ The Environmental impact statement should review the environmental effects of the Avedøre 2 plant and was carried out as described in the Danish law on planning. The Law on planning implements the EU-directive on environmental impact statements into the Danish planning process for major plants.

Furthermore the Municipality has appealed the County's amendment to the regional plan to the Danish Appeal Board for Nature Protection claiming that the County's treatment has been inadequate and that the County was legally disqualified to carry through the EIA-procedure as the County has economic interests in the proposer's activities. The Appeal Board has rejected the appeal. Therefore the Municipality has writ the Appeal Board's decision to the Court of Law.

Recently the Municipality has also appealed the County's environmental permission to the Danish Environmental Protection Agency.

The key players in the formal planning procedure have been:

- The proposer SK Power and ELKRAFT.
- The Minister for Environment and Energy
- The Danish Parliament.
- The Danish Energy Agency.
- The County of Copenhagen.
- The Municipality of Hvidovre.
- The Danish Appeal Board for Nature Protection.
- The Danish Court of Law.
- The Danish Environmental Protection Agency.
- The Ministry for Energy's Planning Department.
- The City Council of Copenhagen.

The public debate.

The Avedøre project has been a major subject in the public debate in Denmark. The project has been discussed in all the major Danish newspapers and other media. Therefore, the project has been debated to an extent which is quite substantial compared to other major plants and infrastructure projects in Denmark. This debate can be seen as the culmination of the general energy debate in Denmark dealing with the subject whether there ought to be built any more coal fired power plants. Furthermore public inquiry's have been carried through by the County of Copenhagen, the Danish Parliament, the Danish Council on Technology Evaluation and the Municipality of Hvidovre.

The latest examples of discussions about the role of major coal fired power plants in the Danish energy system were a few years ago when the electric utilities proposed to build two major coal fired plants in west Denmark. The proposal to build these plants heated up the debate to an extent that had not been seen earlier in Denmark when considering coal fired power plants (however when considering a utility's application to build nuclear power plants in the 1970'ties the discussions and protests grew to larger dimensions). This trend has been further developed in the case of Avedøre 2 which is said to be the most discussed coal fired power plant in Denmark ever.

The main issues discussed in the public debate have been:

- **CO₂ emissions:** The discussion whether coal is acceptable as a fuel for electricity production in Denmark in the future or if natural gas, biomass and renewables should be preferred to reduce emissions of CO₂.
- **Siting:** Local Municipality does not want the plant. Some actors believe that the production technologies should be placed closer to the consumers either by placing a central plant in the Municipality of Copenhagen or by implementing a series of decentralised plants.
- **Need:** Some think that the plant is not needed at all and propose to save heat and electricity in stead or at least to build a smaller plant.
- **Technology:** Some actors think that other types of technologies would be better to use, i.e. decentralised technologies based on renewable energy, natural gas and biomass or heat and electricity saving technologies.

- **Labour:** Unions plead for work-intensive solutions and technologies favouring their own members.
- **Cleaner coal technologies:** Many actors prefer to continue refining the technologies for coal fired power plants in Denmark. Both boilers and environmental technologies have been developed to a high level by Danish manufacturers. These concepts can potentially be exported creating jobs in Denmark.
- **Natural gas:** The Danish gas sector is interested in speeding up the use of natural gas in Denmark. Mainly private companies handle the supply side, while the transmission and distribution is handled by the State and the local Municipalities respectively.
- **Exports:** The proposer wants to have a highly efficient Danish demonstration plant which can later be exported. There is also an urge to use Danish components for the plant. Some Danish industrial companies are very interested in getting an approval of the coal fired plant as they are to deliver some of the components for the plant. These industries also hope that the concept will be exported in the future, so that they will have the chance to deliver components for plants in other countries too.
- **Cost:** The proposer prefers to use coal as a fuel because of the low cost compared to other fuels. The proposer is not interested in being dependent on the Danish gas supplier.
- **Competitiveness:** The proposer aims at strengthening the company's competitiveness by building a new efficient plant and by getting access to buy cheap hydro power.
- **EIA-procedure:** Many actors believe that the EIA-procedure has been an inadequate process as the County was not able to evaluate key concerns adequately and as the alternative proposals given to the County in the public inquiry process have not been assessed thoroughly.

The key players in the public debate have been:

Actors who preferred a central mainly coal fired plant:

- The Danish electric utility SK Power and the other utilities situated on Zealand.
- Danish Metal Workers Union.
- Danish Industries' association.
- The Conservative Party.
- The Liberal Party.
- The Centre Democrats' Party.
- Part of the Social Democrats' Party.

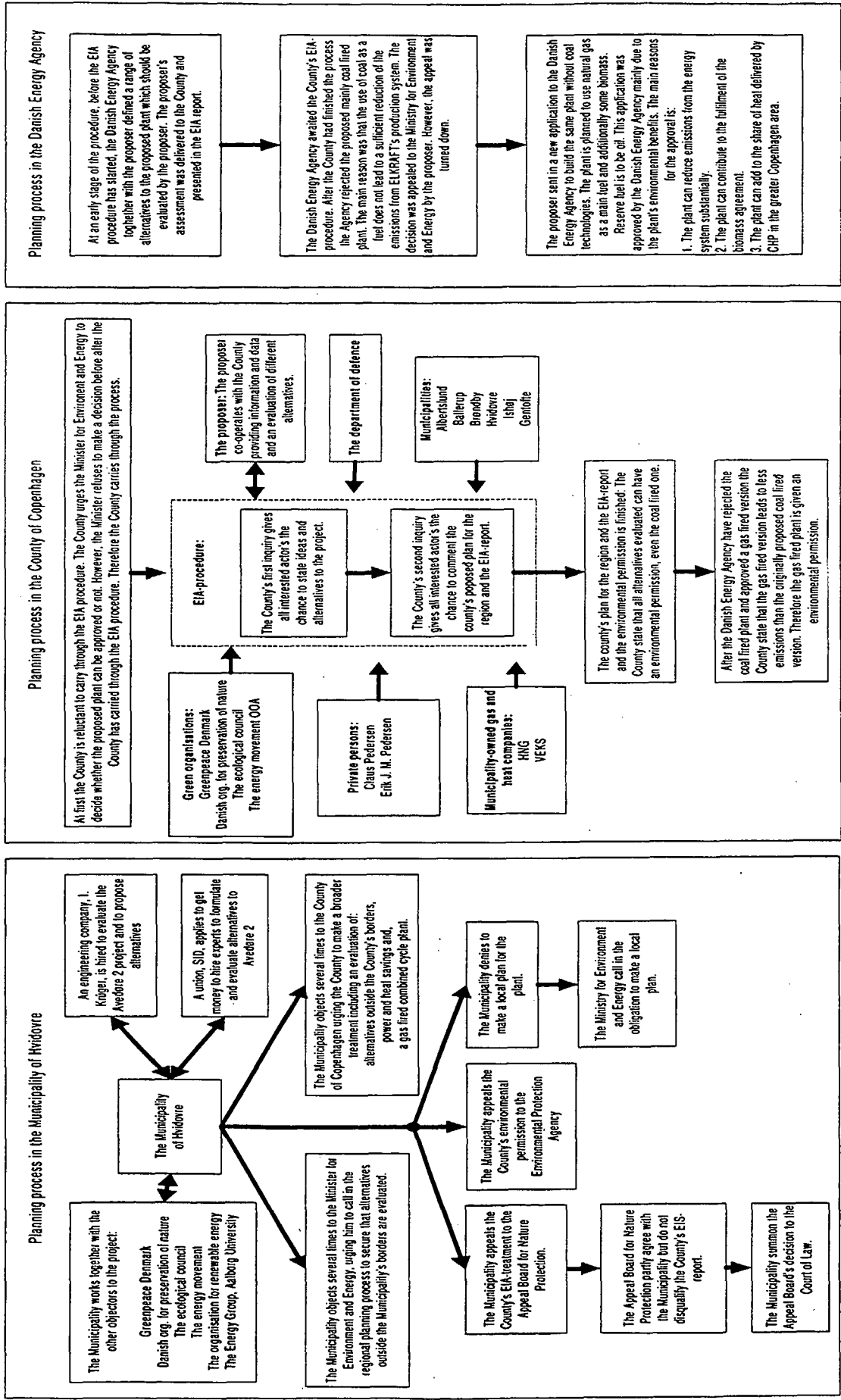
Actors who preferred gas as a fuel:

- The Social-Liberal Party.
- Part of the Social Democrats' Party (among those the Minister for Environment and Energy, who was responsible to give permission to build the plant).
- DANGAS, the gas supplier who delivers gas to centralised plants.

Actors who were against a centralised plant, but for a gas fired plant if it was to be built anyway:

- Danish Special Worker's Union.
- Greenpeace Denmark.
- The Ecological Council.
- The Organisation for Preservation of Nature.
- The energy group from the University of Aalborg.
- The Energy Movement.
- The Municipality of Hvidovre (The local area where the plant is to be situated).
- The Socialist Party.
- The Left Wing Coalition.
- HNG, the gas supplier who delivers gas to decentralised plants.

Figure 9: Illustration of the authorities' planning process.



Chapter 11 - Survey of decision-makers.

This task has been performed to give an account of the attitudes of the most important decision-makers that were involved in the treatment of the proposal to build the Avedøre 2 plant.

Interviews performed.

For the fulfilment of this task 9 persons were interviewed on 7 meetings. All interviews were carried through in the period from May to July 1997. The 9 respondents represent the most important categories of decision-makers that have been involved in the process, i.e. the proposer, the authorities and the green organisations¹¹⁷:

- The proposers of the project, SK Power and ELKRAFT.
- The local authority in the area where the Avedøre plant is planned to be built, the Municipality of Hvidovre, which is responsible of the local planning for the project.
- The Regional authority in the area where the Avedøre plant is planned to be built, the County of Copenhagen, which is responsible of the regional plan for the project, including the obligation to carry through the EIA-procedure.
- The national authority, the Danish Energy Agency, which is responsible of evaluating the proposal according to the overall Danish energy policy goals.
- The three most active green organisations in this matter, The Ecological Council, The Energy Movement and Greenpeace Denmark, who were all involved in the public debate and especially gave input to the EIA-procedure.

The above mentioned interviews are sufficient to illustrate the attitudes of the most important decision-makers which have been involved in the decision-making process. The selection of key decision-makers has been accounted for in Chapter 10, dealing with the sub-task on identification of key players and key issues.

Methodology.

The common questionnaire developed for the "Environmental Risk Project" has been used as a basis for all the interviews in all countries in question. However, it has been necessary to add some questions to the questionnaire which are directly aimed at the Danish case study.

All interviews have been carried through in Danish and are thereafter translated into English by the author. All the questions asked and the respective answers have been typed and are available in a 91 pages appendix report. Typed copies of the interviews have been sent to the respondents shortly after the interview to secure that the respondents feel that everything has been understood correctly. Three respondents have returned their interviews with added changes.

The aim of this Chapter is to summarise the main outcome of the survey. The attitudes of the respondents are presented and discussed under the headlines below, which are thought to cover the main questions that have been raised in the public debate:

- Is the plant needed?
- Which technology is preferable?

¹¹⁷ Interviews with Preben Mac from the Municipality of Hvidovre, 12.05.1997, Jørgen Nørgaard from the Ecological Council, 12.05.1997, Morten Wiese from the County of Copenhagen, 14.05.1997, Sigurd Lauge Petersen from the Danish Energy Agency, 14.05.1997, Erik Knauerhase and Bjarne Hejlskov from the Energy Movement, 15.05.1997, Tarjei Haaland from Greenpeace Denmark, 20.05.1997, Erik Kjær Sørensen from SK Power and Henrik Lous from ELKRAFT, 02.07.1997.

- Which type of fuel is preferable?
- Which site is preferable?
- The EIA-procedure and the EIS-report.
- Environmental concerns.
- Which energy future is preferable for Denmark?

Outcome of the survey.

Is the plant needed?

The proposer mentions the same reasons why the plant is needed as was mentioned in the proposer's project application to the authorities. The proposer believe that the plant is needed for the following reasons:

- To meet the government's CO₂ emission reduction goal
- To meet the government's emission quotas for SO₂ and NO_x.
- To modernise the production system.
- To obtain a higher share of co-produced heat and power in the Copenhagen area.
- To fulfil the agreement made with the Danish government on the use of biomass.
- To be able to cover the growing need for heat in the Copenhagen area with CHP production.
- To improve ELKRAFT's competitiveness and strengthen international relations.
- To export the multi-fuel concept to other countries by having a highly efficient reference plant in Denmark which can demonstrate the viability of the technology.

Furthermore the plant is part of the proposer's agreement with the Swedish energy company Vattenfall. This agreement will give ELKRAFT access to cheap and environmentally sound hydro power from Sweden and is hoped to strengthen SK Power's position on a future liberalised market for electricity in the EU.

The Danish Energy Agency has three main arguments why the plant is needed. First of all the plant is the cheapest mean to realise the official Danish CO₂ reduction goal. Secondly the plant is needed to fulfil the Danish biomass agreement. Finally the plant will increase the share of heat that is delivered by CHP in the Copenhagen area.

The Municipality of Hvidovre and the green organisations do not agree that the plant is needed. They think that it is at least oversized. However, their most important critique is that the plant will impose a major bottleneck to the implementation of alternative technologies like renewables, decentralised CHP plants and energy savings in the future.

Table 13: Summary of the main attitudes towards the need for the plant.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Fulfil strategic agreement with Vattenfall.	No, the plant is not needed, eespecially not within the Municipality's own geographical borders.	NA, in principle the County has no official attitude towards this subject.	Heat from CHP needed in the central Copenhagen area.	NA	Plant oversized.	No, the plant is not needed at all.
Fulfil Danish energy policy goals: Reduce emissions, use more biomass as fuel.			Only way to reach CO ₂ goal.		Plant considered a bottleneck against the implementation of renewables and heat savings.	
Modernise the production system.			Only way to fulfil biomass agreement.			
Cover growing heat needs by CHP.						
Economic competitiveness and strengthen international relations.						
Reference plant for exports.						

Which technology is preferable?

The proposer emphasises the multi-fuel concept's environmental and economical performance and its competitiveness compared to other concepts, like for instance a combined cycle CHP plant or gas fired decentralised CHP plants. One of the proposer's main reasons for choosing the multi-fuel concept is exactly its possibility to shift between fuels. Furthermore, even though the proposer does not know whether it will ever happen, there is still the possibility to add coal burners to the multi-fuel plant in the future, if that becomes necessary. Another aspect mentioned is that the multi-fuel concept is to a large extent based on Danish components.

The Danish Energy Agency has no specific preferences to the type of technology used. However, the important matter is if the technology used can contribute to significantly reduce the CO₂-emissions, increase the use of biomass as a fuel and increase the share of heat delivered by CHP plants in the Copenhagen area.

The approved plant can be seen as some kind of compromise between the proposer and the Danish Energy Agency. The proposer has had the opportunity to build a plant of the multi-fuel type, while the Danish Energy Agency has secured that the plant will give the environmental benefits that they wanted by not using coal as a fuel.

The Municipality of Hvidovre, the Energy Movement and Greenpeace Denmark agree that a gas fired plant is less harmful than a coal fired one. However, they state that it would have been better to implement alternative technologies like energy saving technologies and decentralised gas or biomass fired CHP plants and renewables. As mentioned earlier they fear that the chosen concept will be a major bottleneck to the implementation of such alternative technologies in the future.

The Ecological Council state that it would be best not to build any new production capacity at all, but instead try to implement heat and electricity saving technologies in a large scale.

Table 14: Summary of the main attitudes towards the technology chosen.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Central CHP.	Heat savings.	No preferences, in principle the County has no official attitude towards this subject.	No specific preferences. The important matter is if the technology can secure that the overall political goals can be fulfilled.	Heat and el savings.	Heat and electricity savings.	Heat and electricity savings.
Multi-fuel concept gives cheaper fuels and the possibility to add coal burners later on.	Decentralised CHP.			Decentralised CHP.		
	Not straw.			Combined cycle gas plant.	Decentralised CHP.	Not straw.
Danish components.				Fuel cells plant (future).	Not add coal burners.	
				Not add coal burners.		

Which type of fuel is preferable?

The proposer's first project proposal to build a mainly coal fired plant was rejected by the Danish Energy Agency as it would not be possible to fulfil the national CO₂ reduction scheme with a coal fired plant. The second proposal, a mainly gas fired plant, was accepted by the Danish Energy Agency as it emits less CO₂.

The Government's decision to declare a coal stop came as a surprise to the proposer. The proposer had expected the plant to be approved, maybe with some claims on how much gas that should be used as a minimum or how much coal that should be used as a maximum. They had not expected such a clear rejection of the first proposal.

The Energy Movement and Greenpeace Denmark are satisfied with the coal stop, but would still have preferred renewables and biomass from gas. The Ecological Council and the Municipality of Hvidovre doubt that it should be more environmentally sound to burn straw than not burning it at all.

The proposer has now accepted the coal stop. Henrik Lous from ELKRAFT expressed the proposer's attitude in this way at the interview: *"We call ourselves entrepreneurs of the official Danish energy policy. Therefore we will carry through the changes that are decided by the Danish Parliament."*¹¹⁸ However the proposer is still sceptical as Danish natural gas is expensive. How expensive the gas will be to the proposer was not yet settled when the interview was made. The gas price will not be publicised.

According to the Danish Energy Agency the use of natural gas in Denmark is planned to increase considerably until 2005. After 2005 the coal use is mainly planned to be substituted by biomass and wind power, leading to a total phase out of coal around year 2030. Thereby the natural gas is planned to be used first as a substitute for coal and later as a buffer until the Danish energy system can be transformed in the direction of a totally renewable energy system.

Table 15: Summary of the main attitudes towards the chosen fuel.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Prefer coal as it is the cheapest, but accept gas as the government has declared a coal stop. Important to be able to shift between fuels.	Renewables preferred as they emit less CO ₂ .	No preferences, in principle the County has no official attitude towards this subject.	Gas and biomass preferred because they emit less CO ₂ than coal.	Against coal as it emit more CO ₂ than other fuels.	Against coal as it emit more CO ₂ than other fuels.	NA

Which site is preferable?

As mentioned earlier, the Municipality of Hvidovre does not agree that the plant is needed. However, if the plant is to be build anyway, the Municipality believe that other municipalities in the greater Copenhagen area ought to house their reasonable share of those kinds of supply facilities. There are already numerous major environmentally hazardous installations situated within the Municipality's geographical borders. The Municipality has therefore suggested to build decentralised plants or to build the proposed plant besides the Amager Plant in the Municipality of Copenhagen.

As for the idea to build decentralised gas fired plants instead of a centralised plant the proposer mentions that the heat needs are growing in the greater Copenhagen area. According to the proposer there are almost no heat markets on the rest of Zealand which are not fully supplied already. The proposer states that for environmental reasons it is better to build a central plant as the decentralised plants would be of nuisance to more people in the densely populated Copenhagen area than one central plant situated far away from the consumers.

The proposer argues that the Avedøre site in the Municipality of Hvidovre has already been prepared for the implementation of more production capacity. The district heating transmission net is prepared for an additional plant, the cooling water is available in the bay (the plant is situated on the shore of the Bay), the transport of biomass and other fuels to the plant and waste products away from the plant is convenient as the plant is situated close to a harbour and the freeway. Therefore these transports will not have to go through the city centre or other densely populated areas. Furthermore the needed space for the plant is available. Therefore a lot of factors are in favour of the Avedøre site from other sites in the greater Copenhagen area. On the contrary, the district heating net is not dimensioned for transmission of heat from a range of new decentralised units. Therefore it would be necessary to invest huge amounts of money in the district heating net if a decentralised solution was chosen.

¹¹⁸ Interview with Erik Kjær Sørensen from SK Power and Henrik Lous from ELKRAFT, 02.07.1997.

Table 16: Summary of the main attitudes towards the chosen site.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Avedøre site preferable because: Accessible by sea + highway, infrastructure already there, cooling water available, space available.	Not to be placed at Avedøre. Decentralised, close to consumers.	No preferences, in principle the County has no official attitude towards this subject.	No preferences.	No preferences.	Close to consumers.	Close to consumers.

The EIA-procedure and the EIS-report.

The EIA-procedure.

The Municipality of Hvidovre, the green organisations and the County all agree that the County should not have been responsible of carrying through the EIA-procedure. The problem is that the County only considers itself to be obliged to deal with regional and local matters. The County has in this way limited it's treatment from dealing with national problems such as security of energy supply, fulfilment of national emission quotas, evaluation of the expediency of alternative positions in other Counties and evaluations of which type of fuel or technologies that should be used.

There is general agreement between the County, the Municipality and the green organisations that future EIA-procedures in connection to new power plant projects ought to be treated by an authority which is able and willing to evaluate the proposed project in a more broad sense than what has been possible for the County.

Furthermore the County did not evaluate the alternative proposals to the Avedøre 2 project sent in by different interested parties in the two public inquiry phases adequately. This has led to a situation where the green organisations and the Municipality of Hvidovre feel that the two public inquiry's carried through by the County were amputated. They feel that their contributions to some extent have been a waste of time.

The Municipality of Hvidovre also mentions that the County was legally disqualified to carry through the EIA-procedure as the County is share holder in the energy transmission company NESAs, which is a major share holder (59%) in SK Power.

Generally the respondents mention two different models to restructure the responsibility to carry through the EIA-procedure. Either the Danish Energy Agency or a group of independent experts could be entrusted the task. Morten Wiese from the County emphasise that at the time when the European Commission's directive on EIA was integrated into the Danish law it was discussed whether a separate law should be made or if it should be fitted into the law on environmental protection or the law on planning. It was chosen to put it into the law on planning. *"This has some advantages, for example it has improved the way the public inquiry run and it has secured that different kinds of alternatives have to be considered. These things have generally improved the law. However in cases where there has to be made environmental impact studies of power plants it is not beneficial that the procedure is carried through by us (i.e. the County), as the contents of the environmental impact statement report are not sufficient. Furthermore the Danish Energy Agency is not obliged to make a public inquiry in the treatment of the case. The Danish Energy Agency has not made a big report explaining why they rejected the first plant and why they accepted the second one. This leads to the insufficiency that it is not very easy to see which material that lies behind their conclusions. Maybe, if the law on EIA was made as a separate law, it would be possible to make the law in such a way that this law placed the obligation to carry through the EIA-procedure at the appropriate authority."*¹¹⁹

¹¹⁹ Interview with Morten Wiese from the County of Copenhagen, 14.05.1997.

Another critique mentioned by Greenpeace Denmark and the Ecological Council is that a report with the proposer's evaluation of the inquiry answers was not delivered to them for remarks before closing the inquiry process. The proposer claim that such a procedure would have delayed the EIA-procedure further and thereby also the whole decision-making process. According to the proposer the procedure is already too time consuming.

Not only the green organisations, the Municipality and the County are unsatisfied with the EIA-procedure. The proposer think that it would have been reasonable if the Minister for Environment and Energy and the Danish Energy Agency at an earlier step of the process had decided whether some kind of plant was needed, without deciding on the actual choice of technology. If such an acceptance had been given at an earlier stage of the process it would still have been possible to make an EIS-report evaluating which kind of plant that would be preferable. The problem is that the proposer spent much time on the EIS-report without knowing if the whole work would be a waste of time, i.e. if the Minister decided that the plant was not needed at all afterwards.

The EIS-report.

The green organisations and the Municipality of Hvidovre claim that their alternative proposals were not treated adequately. They are unsatisfied that there was not made a thorough evaluation of alternative technologies like renewables, electricity saving technologies and especially heat saving technologies. Furthermore they feel that the EIS-report should have included alternatives situated outside the County's borders. The project should have been evaluated in a more broad sense considering the structure of the total Danish energy supply sector.

Table 17: Summary of attitudes towards the EIA-procedure and the EIS-report.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
+ Would have liked to have an acceptance from the Danish Energy Agency earlier whether the plant was needed or not. + All relevant information given.	+ The County should not have been responsible of carrying through the EIA-procedure. The procedure should rather have been made by Independent experts. Missing information in the EIS-report: + Heat savings not evaluated. + Sites in other Counties not evaluated.	+ The County should not have been responsible of carrying through the EIA-procedure. The procedure should rather have been made by the Danish Energy Agency. The solution could be to take out the EIA obligation from the law on planning and to make a new separate law on EIA.	+ The EIS-report does not evaluate emissions to the air. + The EIS-report puts focus on local environmental problems.	+ The EIA-procedure was a fake process as the Danish Energy Agency knew that coal was not acceptable. Missing information in the EIS-report: + The inquiry answers should have been put into the EIS-report in their full length. + Furthermore the proposer's evaluation of the inquiry answers should have been sent on to all relevant actors. + The calculations of emissions does not look far enough into the future. The Danish Energy Agency would have been able to make the EIA-procedure.	+ The County should not have been responsible of carrying through the EIA-procedure. The EIS-report should rather have been made by Independent experts. Missing information in the EIS-report: + The proposer's evaluation of the inquiry answers should have been sent on to all relevant actors. + Some relevant economic and emission data were not available. + Sites in other Counties not evaluated.	+ The County should not have been responsible of carrying through the EIA-procedure. The EIA-procedure should rather have been made by Independent experts. Missing information in the EIS-report: + Heat savings not evaluated. + Sites in other Counties not evaluated.

Environmental concerns.

All respondents consider the emissions of CO₂ to be the most important environmental problem.

The Danish Energy Agency is typically most interested in environmental problems which extend further than the County's geographical borders, typically on a national or international level, i.e. emissions to the air of CO₂, SO₂ and NO_x and deposition of ashes from the burners.

The proposer's main environmental concerns are emissions of CO₂, SO₂, and NO_x. Furthermore the proposer is concerned about reducing visual impacts and noise and the impacts of the use of water for cooling.

The County of Copenhagen's basis for evaluating the environmental impacts of the plant is to assess if the emissions of the existing Avedøre 1 Plant and the proposed new plant altogether will stay below the emission limits for large industries put out by the Environmental Protection Agency. Morten Wiese from the County's office of planning states that *"there is no doubt that the most important thing is the emissions of CO₂. However we have only looked at the local environmental problems. These local problems are of minor importance."*¹²⁰ The County has, among other things, looked at the plant's use of water, local truck traffic, noise and emissions of SO₂ and NO_x. The County's evaluation show that all these environmental problems are below the emission limits. The County has therefore given the plant an environmental permission.

Besides the CO₂ emissions the Municipality of Hvidovre and the green organisations mentions problems such as pollution from trucks transporting straw through the local area, unexpediency of burning biomass and unexpediency of a too fast depletion of the Danish natural gas reserves.

Considering the local truck traffic which is unwanted by the local Municipality Morten Wiese from the County's office of planning states that *"our conclusion is that 50 big trucks transporting straw to the plant each day is no problem. Maybe it sounds like much to you, and maybe the traffic can be a bit irritating at Avedøre Holme where the plant is situated, but when they built a waste deposit at Avedøre Holme they planned 300 trucks to drive to that deposit each day, so 50 trucks more or less can not be considered to be a big problem there. And if you look at how the trucks get to Avedøre they go there by the freeway where they do not make any problems. The same is the case if you look at the other end of the travel at the farms where they get the straw. At these sites it does not matter whether the straw material is transported to Avedøre or somewhere else, because the straw have to be transported to power plants anyway. Therefore we have concluded, that the traffic is no problem."*¹²¹

Table 18: Summary of the main environmental concerns.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
Primarily emissions to air: CO ₂ , SO ₂ , NO _x . Cooling water.	Local traffic. CO ₂ .	Only looked at local environmental problems such as use of water, truck traffic, noise and emissions of SO ₂ and NO _x .	Primarily emissions to air: CO ₂ , SO ₂ , NO _x . Ashes.	CO ₂ .	CO ₂ .	Do not use biomass. Truck traffic. Do not use gas reserves too fast.

Which energy future would you prefer for Denmark?

The Danish Energy Agency's latest plan for the development of the energy system emphasises the need for a transformation to a system based on renewable energy sources. This is in line with the preferences of both the Municipality of Hvidovre and the green organisations.

The energy plan is generally accepted by the green organisations and the Municipality of Hvidovre. However, the green organisations criticise the energy plan for putting too little emphasis on the needed effort to save energy. Jørgen Nørgaard from the Ecological Council expresses it in this way: *"I think that the biggest problem with "Energy 21" is that it does only plan the total energy use to be reduced with approximately 17% in 2030 compared to today. This is a very low level of ambition."*¹²² Furthermore the Ecological Council empha-

¹²⁰ Interview with Morten Wiese from the County of Copenhagen, 14.05.1997.

¹²¹ Interview with Morten Wiese from the County of Copenhagen, 14.05.1997.

¹²² Interview with Jørgen Nørgaard from the Ecological Council, 12.05.1997.

sises that Denmark's natural gas reserves are limited and that it would be better to use the gas at a lower pace.

Table 19: Summary of the main wishes for Denmark's energy future.

Proposer, SK Power	Municipality of Hvidovre	County of Copenhagen	Danish Energy Agency	Greenpeace Denmark	Energy Movement	Ecological Council
The proposers considers themselves as entrepreneurs of the official Danish energy policy. Therefore they will try to fulfil the political goals for the future energy system.	Renewables. Heat and electricity savings.	NA, in principle the County has no official attitude towards this subject.	Renewables, but gas preferable as a fuel until the energy system has been transformed in a more renewable direction, as gas emit less CO ₂ than coal.	Heat and electricity savings. Renewables.	Priority list: 1) Savings 2) Scrap coal + nuclear 3) Renewables 4) Natural gas. I.e. an energy future with less use of energy which should be produced by renewables.	Heat and electricity savings. Do not use Danish natural gas reserves too fast.

Chapter 12 - Preparation of the authorities' treatment and early objections from opponents.

SK Power's plans to build Avedøre 2 were published long before SK Power sent in the application. Already when the existing Avedøre 1 plant was built the site and some infrastructure were dimensioned for an additional plant. In December 1992 ELKRAFT's "Plan 92/93" had been adopted by ELKRAFT's board of directors, and the Avedøre 2 plant was part of it¹²³. Thereafter SK energy started making a draft proposal of the project.

Preparation of the authorities' treatment.

At an early stage of the projecting phase the proposer had contacted former Minister for Energy Jann Sjørnsen to have his approval of starting up a co-operation between SK Power, ELKRAFT and the Danish Energy Agency to make some preliminary analysis' of the Avedøre 2 project before the formal application was sent in. Several meetings were held between the parties to discuss the authorities' treatment of the application that was to come from SK Power and to discuss the technical reasons for building Avedøre 2 as for example the expected future heat needs in the greater Copenhagen area and the potential to save electricity.¹²⁴

Already at this early stage of the process the Danish Energy Agency and the proposer defined a range of alternatives to the proposal that ought to be evaluated. The criteria for the comparison was also decided upon. For example it was decided that the time perspective for the calculations of emissions should look ahead until 2015. Furthermore the assessment of alternatives should contain a comparison of the following parameters:

- Economy,
- Environmental performance,
- Supply safety,
- Robustness,
- Competitiveness

Furthermore the Energy Agency wished to have more specific statements for the following parameters:

- Energy- and effect balance for the ELKRAFT area,
- Fuel use and supply,
- Security of electricity supply, ability to switch over production and flexibility of the system,
- Coverage of heat demand, including the steam based system,
- Emissions of SO₂, NO_x and CO₂,
- Connection to extension of the transmission system,
- The alternatives' consequences for the Vattenfall agreement and

The proposer's evaluation of the alternatives has been described in an earlier Chapter. As described earlier heat savings were not among the alternatives that were assessed.¹²⁵

Early objections from opponents.

Early in the procedure, in March and June 1993, the proposer invited the Mayor from the Municipality of Hvidovre and representatives for the Municipality's Technical Department to several meetings where the multi-fuel concept and the biomass concept were presented¹²⁶. However the proposer could not convince the representatives from the Municipality that the plant was a good idea. On the contrary the Municipality of Hvidovre

¹²³ ELKRAFT, 1993 (a).

¹²⁴ ELKRAFT, 27.04.1994 and ELKRAFT 04.07.1994.

¹²⁵ ELKRAFT, 27.04.1994.

¹²⁶ Krüger, 07.04.1995.

was in opposition to the plan to build a new power plant within the Municipality's geographical borders. The Mayor doubted whether any additional major CHP plants were needed in Denmark at all and proposed to implement heat savings in stead.¹²⁷ The Municipality hired a consulting engineering company, I. Krüger, to evaluate the Avedøre 2 project as the Municipality had doubts about the consistency of the calculations and the technical evaluation made by the proposer.¹²⁸

22 September 1994 the proposer sent in the application to the Energy Agency. It was the day after an election for the Danish Parliament which led to the formation of a new government and put the recent Minister for Environment and Energy, Svend Auken, in office. The proposer knew that the plant would probably not have been approved by the former Minister for Energy, Jann Sjørnsen from the Christian Party, as he was known to be in opposition to building any more coal fired plants in Denmark. Therefore the application had probably awaited a new political regime.

However, already in November and December leading members of the government, the Minister for Environment and Energy, Svend Auken, and Martin Glerup from the Social Democrats' Party and Elsebeth Gerner Nielsen from the Social-Liberal Party, stated that a further expansion with coal fired plants would not be in line with the CO₂ reduction scheme for 2005.¹²⁹

In November 1994 the green organisations, Danish Special Workers' Union (SID) and the weekly paper *Ingeniøren* had been given the right of access to all official documents concerning the Avedøre case by the Danish Energy Agency¹³⁰. However, some of the data in one of the proposer's most crucial documents, namely their comparison of the alternatives, were not publicised at first because the proposer claimed the concealment of those to be of vital importance for the company's competitiveness. They claimed that their bargaining position when buying and selling electricity or when buying gas would be depreciated if releasing the data. Greenpeace, the Energy Movement and SID stated that data for the plant's environmental performance ought to be published. The daily newspaper *Information* treated the case with special attention in a range of articles by criticising the concealment of data that hindered a thorough debate on the plant's environmental performance.¹³¹ Later in December the Energy Agency decided to publish the environmental data. Still, information on the amount of electricity exports to Germany through the KONTEK sea cable and information on SK Power's expenses for Swedish hydro power and natural gas as fuel for the plant were kept secret.¹³²

Furthermore, the opponents feared that the authorities, i.e. the Parliament, the Minister for Environment and Energy and the Energy Agency, would repeat their failure from the earlier treatment of the North Jutland Power Plant by approving the Avedøre 2 plant before the County had carried through the EIA-procedure, a so called "reverse EIA-procedure". A Danish expert in the criteria put out in the law on planning about EIA, Ulf Kjellerup, criticised the County for refusing to carry out the EIA-procedure before after the Energy Agency had treated the application from SK Power¹³³. Therefore, a few days later, the Minister for Environment and Energy stated that he agreed that, from a legal point of view, there was no doubt that the EIA-procedure had to be carried out before the Energy Agency could finalise their treatment, i.e. by rejecting or approving the proposal. Furthermore the Minister added the political appraisal that it would not be sensible to decide upon a certain solution and thereafter assess the environmental performance of that solution. On the contrary the environmental assessment of the proposal and alternatives is meant to be the basis of the decisions taken.¹³⁴ These legal and political judgements can be seen as a direct outcome of the Danish Appeal Board for Nature Protection's first judgement in connection to the treatment of the North Jutland Power Plant, which was de-

¹²⁷ Christensen, 27.02.1994.

¹²⁸ Krüger, 07.04.1995.

¹²⁹ Tornbjerg, 18.11.1994 and Nielsen, 07.12.1994.

¹³⁰ Danish Energy Agency, 17.11.1994 and Danish Energy Agency, 14.12.1994 (a).

¹³¹ Nielsen, 07.12.1994, Nielsen 08.12.1994, Nielsen, 12.12.1994 and Nielsen, 15.12.1994.

¹³² Danish Energy Agency, 14.12.1994 (b).

¹³³ Nielsen, 12.12.1994.

¹³⁴ Nielsen, 17.12.1994.

scribed in Chapter 9. It can also be seen as if it was the Minister's conviction that the EIA-procedure for the North Jutland Power Plant had not been in accordance with the regulations put out in the law on planning and the European Council's Directive on EIA.

In February 1995 the Municipality of Hvidovre stated that the plant's environmental consequences were unwanted within the Municipality's geographical borders, as ELKRAFT's prognosis estimated that the growth in heat demand would mainly appear in the central parts of Copenhagen. The main environmental arguments against the plant were of a local kind. The expected growth in heavy traffic through the Municipality, as a consequence of trucks transporting straw and residuals, was considered to be the main environmental problem. Furthermore the use of cooling water leading to a higher temperature in the recipient, Køge Bay, emissions of waste water from processes at the plant and problems with coal dust in the air were mentioned too.¹³⁵

At this early stage of the process the Municipality's main arguments against the plant were the local environmental problems. However, the Municipality's co-operation with the consulting engineering company and the green organisations who were also in opposition to the plans to build the coal fired plant led to a redefinition of the strategy. Focus was moved from the local problems to the problems of national interest, i.e. if the plant was needed at all and whether there were other technological solutions which were more in accordance with the overall national energy policy. The Municipality worked together with the following actors:

- Greenpeace Denmark.
- The Energy Movement.
- The Ecological Council.
- The Organisation for Renewable Energy.
- The Organisation for Preservation of Nature.
- The Energy Group from the University of Aalborg.
- Danish Special Workers Union (SID).

An important part of the opponents' strategy was to request the Danish Energy Agency to give a grant to set down a group of independent experts to evaluate ELKRAFT's technical, economical and environmental study of the Avedøre 2 project and to define and evaluate alternatives to the Avedøre 2 project and compare these to ELKRAFT's evaluation. The opponents thought that it was unreasonable that ELKRAFT alone had evaluated the alternatives and compared these to their own project. The opponents felt that the following parameters should be evaluated in more detail:

- The potential to save heat in the greater Copenhagen area.
- The potential to use renewable energy technologies in ELKRAFT's energy system.
- The potential to establish decentralised CHP plants.

Especially the opponents emphasised the need for an independent evaluation of the potential to save heat. In a letter to the Minister the Ecological Council emphasised that more attention ought to be drawn upon the plant's consequences for the emissions of CO₂ after 2005. According to the Council it is not sufficient to aim at the short term reduction goal without thinking of whether a further reduction can be maintained after 2005. Heat savings are considered to be crucial to reach substantial reductions in the future.¹³⁶

The reason why heat savings are considered to be so crucial by the green organisations can be exemplified by a statement in a letter from the Energy Movement to the Social Democrat Martin Glerup: If the emissions of CO₂ have to be reduced after 2005 a considerable scaling down in the use of coal and gas as fuel will be needed. The production of electricity will to a large extent have to be generated by wind turbines and solar

¹³⁵ Municipality of Hvidovre, 21.02.1995.

¹³⁶ Ecological Council, 24.04.1995.

cells which do not produce heat as a residual product. Therefore heat savings will be necessary also in areas supplied by CHP as the production of heat and electricity are expected to be de-coupled.¹³⁷

The opponents fear that the utilities will not be able to implement heat savings: *"It is too much to demand that supply companies, as well electric utilities as heat companies, should aim for a reduction in demand. The Ecological Council thinks that it will be necessary to establish new energetic institutions to implement heat and electricity savings"*. Therefore, first of all, it is necessary to give money for independent experts to assess the potential to save.¹³⁸ However, the Minister's answer to the request is that the distribution companies are responsible for the savings assessment. Furthermore the Agency and DTI (Danish Technological Institute) have started up an assessment of the potential to save heat. Therefore he does not feel that an additional assessment is needed.¹³⁹ The assessment of heat savings from DTI was later heavily criticised by opponents for over estimating the cost. Especially the opponents argued that heat savings could be obtained much cheaper if implementing heat saving technologies in connection to the ongoing city renewal scheme.

Furthermore the opponents requested the Minister for Environment and Energy to call in the EIA treatment that was under preparation in the County.¹⁴⁰ The opponents feared, with the treatment of the North Jutland Power Plant in mind, that the County would not be able to evaluate alternatives defined by the public adequately. Especially they stressed that the County might not be obliged to evaluate alternatives situated outside the County's geographical borders, i.e. decentralised CHP plants, heat and electricity savings, renewables and other sites for the multi-fuel plant. Furthermore the Municipality emphasised, that the County of Copenhagen, through their ownership of 22% of NESA, which owned 59% of SK Power and thereby their ownership of 10,38% of ELKRAFT, were disqualified for carrying out the EIA-procedure due to the County's own economic interests in the proposer's economic turnover.¹⁴¹

The opponents' request to refer the EIA treatment to the Ministry was turned down by the Minister for Environment and Energy. He emphasised that it is the Ministry's conviction that the Danish EIA regulations implement the European Directive's claims for evaluation of alternatives. The County has the authority to carry through the EIA-procedure and are considered to be able to assess alternatives outside the County's geographical borders. If the County wishes to assess alternatives outside the County's borders the County ought to contact the proposer and the other counties which might be involved in preparation for making a joint assessment of the alternatives in question.¹⁴²

The fact that the evaluation of alternatives was carried out by the proposers themselves and that the alternatives proposed by the objectors were never evaluated thoroughly by independent experts and the fact that the County carried out the EIA-procedure became the main problems emphasised by the objectors all the way through the authorities' treatment process.

¹³⁷ Energy Movement, 03.04.1995.

¹³⁸ Ecological Council, 24.04.1995.

¹³⁹ Danish Ministry for Environment and Energy, 06.06.1995 (a).

¹⁴⁰ Greenpeace Denmark et.al., 31.03.1995.

¹⁴¹ Municipality of Hvidovre, 21.03.1996 (b).

¹⁴² Danish Ministry for Environment and Energy, 30.06.1995.

Chapter 13 - The County's EIA-procedure.

The County was reluctant to carry out the EIA-procedure.

The County was reluctant to carry out the EIA-procedure until after the treatment had been finished in the Danish Energy Agency. The reason was that the County felt that it would be a waste of time to carry out the procedure if the Minister rejected the proposal to build the plant afterwards. Two parameters were still uncertain at this time of the process, namely whether the plant's production of energy will be needed at all and whether the plant ought to be fuelled by natural gas or coal. According to the chairman of the County's Technical Committee at least these two parameters ought to be settled before moving on with the EIA-procedure.¹⁴³

The Danish Energy Agency and the Minister for Environment and Energy were unsatisfied with the County's reluctance. The reason for this was that the Danish Energy Agency had run into an appeal from the Danish Appeal Board for Nature Protection in the earlier treatment of another major power plant in North Jutland a few years earlier. At that time the Appeal Board maintained that alternatives to the plant should have been included in the County's EIA-procedure before approving the proposal. The Danish Energy Agency did not want to run into the same problems once more.¹⁴⁴ Therefore the Minister for Environment and Energy announced, that from a legal point of view there was no doubt that the County had to carry out the regional planning procedure before the Danish Energy Agency could state their final decision.¹⁴⁵

The County continued to refuse to carry out the EIA-procedure until after the Danish Energy Agency had treated the application from SK Power. Therefore the Agency announced that they would not finalise their treatment before after the EIA-procedure had been carried out by the County. The Agency obliged the County to evaluate a range of different alternatives to the Avedøre 2 project in the environmental impact statement and stated that the Agency would be ready to deliver material on those alternatives.¹⁴⁶

In March 1995, the County of Copenhagen announced, after pressure from the Ministry and the Energy Agency, that the County would carry out first part of the regional planning procedure, i.e. the first public inquiry where the public was given the possibility to state their opinions to the project and to suggest alternatives. However, the fears of the green organisations were justified, as the County stated that on the grounds of the Appeal Board's decision concerning the North Jutland Power Plant a few years earlier they were not obliged to evaluate alternatives outside the County's borders. Therefore the County did not intend to carry out such evaluations. The County expected that such alternatives would be assessed by the Energy Agency.¹⁴⁷

31 March 1995 the Minister for Environment and Energy commented the request from the green organisations by stating that the County could, if they wanted to, request the proposer SK Power to define alternatives to Avedøre 2 situated outside the County's borders and evaluate the environmental impacts of those alternatives in co-operation with the neighbouring County or counties in question. However the Minister agreed with the legal assessment made by the County, that the County was not obliged to necessarily evaluate alternatives outside the County's borders. The Minister felt that the environmental impact statement could be treated adequately by the County so he found no reasons to take over the regional planning process.¹⁴⁸

The County's reluctance to carry out the regional planning process before the Agency had treated the proposal, carried on for several years and the opponents continued to urge the Minister for Environment and

¹⁴³ County of Copenhagen, 05.05.1995 and Nielsen, 14.12.1994.

¹⁴⁴ Nielsen, 12.12.1994.

¹⁴⁵ Nielsen, 17.12.1994 and Nielsen 14.12.1994.

¹⁴⁶ Danish Ministry for Environment and Energy, 30.06.1995.

¹⁴⁷ County of Copenhagen, 19.04.1995.

¹⁴⁸ Danish Ministry for Environment and Energy, 30.06.1995.

Energy to take over the regional planning procedure. However the Minister wanted the County to carry out the process.

The output of the first public inquiry.

17 May 1995 the County Council of Copenhagen decided to carry out a public inquiry where all interested parties could give ideas and propositions to the proposed plant¹⁴⁹. The inquiry lasted from 12 June until 31 August 1995. In the inquiry material, the County emphasised that overall energy political and supply security considerations would not be accounted for in the County's treatment of the project. Neither would the treatment include an evaluation of alternatives to the proposed plant situated outside the County's geographical borders. Those ideas, proposals or protests that might appear in the public inquiry, which were not related to the County's legal authority would be sent on to the Danish Energy Agency.¹⁵⁰

The County's first inquiry gave all interested actors the chance to formulate ideas and propositions to the Avedøre 2 project and to formulate alternatives. The County received comments from the 17 following actors:

- From the Ministry for Defence.
- From Municipalities: The Municipalities of Albertslund, Ballerup, Brøndby, Hvidovre, Ishøj and Gentofte and minority statements from groups of Municipal politicians: The Socialist Folks Party in Albertslund and the Left Wing Coalition in Albertslund.
- From municipality owned gas and heat companies: HNG and VEKS.
- From green organisations: The Organisation for Preservation of Nature, the Ecological Council, Greenpeace Denmark and the Energy Movement.
- From private persons: Erik J. M. Pedersen and Claus Pedersen.

The main arguments in these comments were as follows:

Neutral actors:

The Ministry for Defence, VEKS, and the Municipalities of Albertslund, Brøndby and Gentofte had no remarks to the project.

The Municipality of Ballerup had no remarks except that the construction of the plant ought to be followed up by the phasing out of older plants in the ELKRAFT area.¹⁵¹

Actors who wanted gas firing instead of coal firing:

The Municipality of Ishøj and the two private respondents, Claus Pedersen and Erik J. M. Pedersen, proposed that the plant ought to be natural gas fired because of the lower local environmental pollution of a gas fired plant compared to a coal fired plant. Furthermore Claus Pedersen objected to the plant's use of biomass due to the associated pollution from heavy traffic transporting straw to the plant.¹⁵²

Objectors to a central plant:

HNG, the gas distributor in the greater Copenhagen area, proposed that the decentralised natural gas fired alternative should be chosen in stead of Avedøre 2. The background for HNG's wish was that HNG would be the company to deliver the natural gas for the decentralised plants. If a central gas fired plant was built the gas would be delivered by another gas company, DANGAS.¹⁵³

The Municipality of Hvidovre announced in their comment that the Municipality had requested the Minister for Environment and Energy to take over the EIA-procedure as the Municipality found that the County was inca-

¹⁴⁹ Danish Ministry for Environment and Energy, 06.06.1995 (b).

¹⁵⁰ County of Copenhagen, may 1995.

¹⁵¹ County of Copenhagen, 25.10.1995.

¹⁵² County of Copenhagen, 25.10.1995.

¹⁵³ County of Copenhagen, 25.10.1995.

pable of carrying out the process. Furthermore the Municipality argued that SK Power and ELKRAFT had not made it clear whether the heat demand will make it necessary to build the plant. Even if there will be demand for more heat in the future, the Municipality proposed to build decentralised natural gas and biomass powered plants instead.¹⁵⁴

In the minority statements from groups of Municipal politicians from the Municipality of Albertslund the main arguments were that investing in the central plant will be a bottleneck to reach a more sustainable energy policy in the future. Furthermore the minorities felt that the money ought to be invested in electricity and heat savings in the greater Copenhagen area and renewable energy technologies. The minorities also complaint that ELKRAFT has not fairly rendered the future heat demand or evaluated enough alternatives to Avedøre 2, and that the County was not ready to evaluate the Avedøre 2 project in a more broad sense according to the national energy policy.¹⁵⁵

The green organisations, the Organisation for Preservation of Nature, the Ecological Council, Greenpeace Denmark and the Energy Movement, are all objectors to the Avedøre 2 project. They all feel that it is regretful that the County did not intend to evaluate alternatives to Avedøre 2 outside the County's borders and that the environmental statement is only thought to be covering environmental effects within the County's borders. The green organisations' main arguments are that the investments for Avedøre 2 ought to be used for electricity and heat savings in the greater Copenhagen area and decentralised plants powered by natural gas, biomass and renewables.¹⁵⁶

The environmental impact statement.

In the environmental impact statement, the County evaluated environmental impacts of the proposed Avedøre 2 plant, such as:

- Impacts of traffic,
- Visual impacts,
- Risk of major accidents,
- Risk of oil leaks,
- Impacts of waste and residuals,
- Impacts of re-burning residuals like gypsum and sludge,
- Impacts of coal dust in the air,
- Reductions of emissions of NO_x, SO₂ and CO₂ to the air in the ELKRAFT area,
- Immissions of NO_x and SO₂ in the air in the local area,
- Impacts of water use,
- Impacts of emitted cooling water to the bay,
- Impacts of emitting waste water to the bay,
- Impacts of emissions of heavy metals and
- Impacts of noise.

The County's conclusion is that the environmental impacts of the originally proposed mainly coal fired plant will not preclude the siting of the plant in Avedøre adjacent to the Avedøre 1 plant, as the environmental impacts are of acceptable dimensions.¹⁵⁷ In other words the County was prepared to give the proposed Avedøre 2 plant an environmental approval according to the law on environmental protection.

Furthermore the County's environmental impact statement contained ELKRAFT's evaluation of a range of alternatives to the Avedøre 2 project. The County simply re-printed the information's from ELKRAFT that are described in Chapter 5 into the text of the environmental impact statement.

¹⁵⁴ County of Copenhagen, 25.10.1995.

¹⁵⁵ County of Copenhagen, 25.10.1995.

¹⁵⁶ Danish Organisation for Preservation of Nature, 23.8.1995, Energy Movement, 30.8.1995 and Greenpeace Denmark, 30.8.1995.

¹⁵⁷ County of Copenhagen, January 1996 (a), p. 65-108.

The County stated that all the alternatives assessed by ELKRAFT, except for the status quo solution, will have less or equal impact on the environment. Therefore all these alternatives could also be accepted by the county, i.e. if the Danish Energy Agency chose to reject the proposed project for national energy policy reasons then the proposer could get other alternatives approved by the County according to the law on environmental protection, as long as these alternatives did not exceed the environmental impacts caused by the proposed mainly coal fired plant.¹⁵⁸

Finally the County's environmental impact statement contained an evaluation of the different alternatives proposed by different actors in the first inquiry process. This evaluation had been made by the proposer SK Power in co-operation with ELKRAFT. SK Power/ELKRAFT rejected all the alternatives formulated in the first inquiry process as being inadequate for reaching the national emission goals, for using the biomass with high efficiency and for securing the implementation of wind turbines and decentralised plants. According to SK Power/ELKRAFT the alternatives were all focusing on large scale implementation of specific strategies as for example heat savings and decentralised plants. SK Power/ELKRAFT stated that the proposed Avedøre 2 plant was the best solution to reach the national emission reduction goals and ELKRAFT's future goals.¹⁵⁹

The output of the second inquiry process.

In January 1996 the County of Copenhagen started an inquiry process of the environmental impact statement. The inquiry process lasted 8 weeks.

The objectors to the project, i.e. the green organisations and the Municipality stated that they were disappointed that the County had not assessed their alternative proposals adequately. The arguments were of the same kind as in the first inquiry process.

The final output of the County's regional planning process.

The amendment to the regional plan was approved by the County's Council of politicians 19 June 1996. The County's Council approved the Avedøre 2 project as proposed by SK Power and thereby let the Minister for Energy and his government take the final decision afterwards.

¹⁵⁸ County of Copenhagen, January 1996 (a), p. 135-136.

¹⁵⁹ County of Copenhagen, January 1996 (a), p. 137-154.

Chapter 14 - The treatment by the Danish Energy Agency.

The rejection of the first application.

28 June 1996 the Energy Agency announced that the application from SK Power to build Avedøre 2 could not be accepted. The decision was based partly on the material about the project that had been delivered to the Agency by the proposer and partly on the scenario calculations for the future Danish energy system which were presented in the government's latest energy plan "Energy 21" in April 1996¹⁶⁰. The Agency's evaluation of the project was first given to the proposer in a memorandum 24 June 1996. The criteria put out in this memorandum were commented by the proposer and discussed in a series of letters between the Agency and the proposer before the official rejection was given a few days later. The department's evaluation of the project and the proposer's comments to it were as follows¹⁶¹:

Subject:	Energy Agency's arguments:	Proposer's comments:
Need for the plant	The plant will not be needed in the winter 1999/2000.	The proposer's arguments why the plant is needed are described in an earlier Chapter.
Electricity demand	The Agency's prognosis for electricity demand shows that the plant will probably be needed in 2004. This prognosis is based on the implementation of a sea cable between west and east Denmark in year 2000.	The demand for electricity is not among the proposer's arguments for the need for the plant.
Heat demand	The Agency states that the plant will be needed to deliver heat in 2004 if the old plants Amager 1 and 2 are scrapped. The Agency estimates that hastening the implementation of the plant in year 2000 for the fulfilment of the demand for heat alone is a bad idea for economical reasons.	The proposer states that the heat prognosis used by the Agency in the energy plan "Energy 21" is too low. The old plants Amager 1 and 2 can not be scrapped when Avedøre 2 starts producing. Furthermore, when the Avedøre 2 plant is put into production the share of heat delivered by CHP in the greater Copenhagen area will still be low as compared to other areas.
CO₂	The Agency finds that the proposed coal fired plant and the Vattenfall agreement are not sufficient to fulfil the national CO ₂ reduction scheme. The planned development in the energy plan "Energy 21" is based on the implementation of one new major gas fired plant in Copenhagen in the period until 2005. According to the Agency this solution is the only way to fulfil the CO ₂ reduction scheme.	The proposer states that the CO ₂ reduction scheme can be fulfilled even with the implementation of a partly coal fired plant. However this would acquire the implementation of additional coupled gas turbine capacity. According to the proposer a gas fired plant can only be justified if the political aim is to stop the use of coal as a fuel in Denmark as fast as possible. Furthermore the delay of the plant until 2004 will entail an accumulated CO ₂ emission which will be difficult to overtake later on.

¹⁶⁰ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

¹⁶¹ Danish Energy Agency, 24.06.1996, Danish Energy Agency, 25.06.1996, ELKRAFT, 25.06.1996, SK Power 28.06.1996 and Danish Energy Agency, 28.06.1996.

Subject:	Energy Agency's arguments:	Proposer's comments:
SO₂ and NO_x quotas	The Agency rejects that the plant's contribution to meet the SO ₂ - and NO _x -quotas can in itself substantiate the decision to build the plant. The Agency agrees that there might be problems meeting the quotas for a short period of time. However, as a new plant is to be built soon after year 2000 the problem is of minor importance.	The proposer states that after year 2000 it will be indefensible to produce considerable amounts of energy on plants which are not equipped with facilities for desulphurization. Furthermore as the proposer expect to be prepared to produce electricity for exports both for the open European market and for the Nordic hydro power areas in seasons with less rain the quotas will have to be met with a wider margin than expected by the Agency, i.e. because the quotas are not correlated for exports and imports but tied to the producing country.
Biomass	The Agency estimates that the biomass agreement can be fulfilled by building other plant types, for example a separate plant. Though the Agency admit that a delay of the implementation of Avedøre 2 will also delay the fulfilment of the biomass agreement.	The proposer agrees on the Agency's comment, but add that a separate biomass fired plant will be much more expensive and will have a 20-30% lower efficiency.
Economy	The Agency estimates that the plant and the Swedish hydro power combined will not be cheaper than alternative solutions such as a gas fired combined cycle plant.	The proposer accuses the Agency for comparing the price to combined cycle plants in countries where the price is lower than it will be in Denmark.
Fuel	The Agency finds it problematic that SK Power had not been willing to give information's on which fuel mix they intend to use in the plant.	The proposer states that it will take two years to add coal facilities to the multi-fuel plant and probably additionally two years to get an approval to do so. Therefore the plant's security of supply is not as good as for a plant with coal facilities.
Employment	The Agency agrees with the proposer that the employment effect of a coal fired plant will be higher than of a gas fired plant due to the higher investments and due to the possibility of buying the de-NO _x facilities from Danish producers.	
Reference plants/technology	The Agency finds that there are enough reference plants in Denmark already. The	The proposer states that the multi-fuel concept as well as single components of

Subject:	Energy Agency's arguments:	Proposer's comments:
	<p>Agency does not agree that a demonstration plant is needed to be able to export the multi-fuel concept or the environmental facilities. Furthermore the Agency have doubts concerning the multi-fuel concept's export potential.</p> <p>The Agency emphasise that CC-plants have electric efficiencies in the order of 60% as compared to the Multi-fuel concept's 50%.</p>	<p>the plant can potentially be exported. Especially countries at the Baltic Sea and in the Far East are considered to be interesting markets. These countries are considered to be most interested in using coal. The proposer is confident that a demonstration plant is needed to support the export potential.</p>
Vattenfall agreement	<p>The Agency has not been able to verify whether the Vattenfall agreement will be cancelled or if SK Power will still have access to hydro power if the multi-fuelled Avedøre 2 plant is not ready for production in the winter 1999/2000.</p> <p>Furthermore the Agency estimates that the Vattenfall agreement's effect on the national CO₂ scheme is fairly neutral.</p>	<p>The Vattenfall agreement secures the possibility to have an effective interplay between Swedish hydro power and Danish wind power and CHP production.</p> <p>SK Power ascribes the access to cheap hydro power on favourable economic terms an economical and strategic value which alone justify an advance of the implementation of the Avedøre 2 plant to the winter 1999/2000.</p>

The main criteria for the Danish Energy Agency's rejection of the project was that the proposed plant could not give the environmental benefits needed.¹⁶² In a press release from the Ministry for Environment and Energy the Minister comment the Agency's rejection of the plant by stating what is probably the core of the problem with the proposed coal fired plant: "...there exist alternatives which are environmentally more sound and cheaper. For example a modern gas fired plant would be much more in accordance with the new energy plan "Energy 21". A gas fired plant would give a considerably higher CO₂ reduction and at the same time have markedly lower investment needs..."¹⁶³

The Energy Agency's rejection of the project came as a big surprise to SK Power. SK Power reacted to the decision by stating that the rejection was an energy political failure leading to a situation where the emissions from the energy system as a whole can not be reduced in accordance to the Government's environmental goals and furthermore might be a bottleneck to the company's access to environmentally sound and cheap hydro power from Sweden and to the company's possibilities to compete on the future liberalised market for electricity within the European Union.¹⁶⁴ Therefore SK Power appealed the decision to the Ministry for Environment and Energy 4 July 1996¹⁶⁵. The appeal was treated fast in the Ministry and rejected 9 July 1996. The background for this very fast treatment in the Ministry was that the Minister for Environment and Energy, Svend Auken, had already confirmed his attitude to the proposed plant as he was the responsible authority behind the Energy Agency's refuse. In this way a peculiar situation appeared as the legal authority to treat SK Power's appeal was the same authority which had rejected the approval in the first place.

¹⁶² Danish Energy Agency, 28.06.1996.

¹⁶³ Danish Ministry for Environment and Energy, "Press release", 28.06.1996.

¹⁶⁴ SK Power, "Press release", 28.06.1996.

¹⁶⁵ SK Power, 04.07.1996.

Disagreements at the technical level.

As can be seen from the description above the Energy Agency and the proposer disagreed on a number of points mostly due to their different goals, ways of thinking and the assumptions used in their technical and economical evaluations. One example of the uncertainties connected to the evaluation of the expediency of the plant compared to other alternatives is the disagreement on the use of technology. The Agency is in favour of a gas fired CC-plant while the proposer prefer the mainly coal fired multi-fuel concept. In the following section we give a short summary of a discussion between the Agency and the proposer which took place in the days immediately before the plant was finally rejected. The aim is to exemplify how different assumptions and goals has led to the disagreements on the use of technology.

In the table below is shown the proposer's comparison of the investment needs for the proposed project and two CC-plants of differing sizes. The investment needs for the proposed plant are expected to be 3300 MDkr of which the proposer is to pay 1980 MDkr while Vattenfall's share is 1320MDkr. The investments needed for a CC-plant with a similar electric capacity or a similar heat output are estimated at 2200 MDkr and 3490 MDkr respectively. Thereby there is no doubt that the investment needs are lower for CC-plants than for plants of the multi-fuel type.

Table 20: The proposer's comparison of investment costs in different plant types.

	Electric capacity (MW)	Heat output (MJ/s)	Investment (MDkr)	SK Power's share (MDkr)
The proposed plant	460	480	3300	1980
CC-plant with same electric capacity	460	302	2200	
CC-plant with same heat capacity	730	480	3490	

Source: Danish Energy Agency, 25.06.1996.

As SK Power has already spent 120 MDkr on the project the total investment needed is 3420 MDkr. However, SK Power claims that after negotiations with the contractors the price has already been lowered by 400 MDkr. The proposer therefore expects that the investment needs will not be higher than 2900 MDkr. The comparison of investment needs for different proposals is thereby difficult to make, as the expected investment costs can change considerably in the time between the projecting phase and the implementation. The material from the proposer gives no information whether a similar price reduction could be achieved for CC-plants.

Another discussion is concerning whether the investment for Swedish hydro power capacity should be considered as part of the proposed project's cost or not. The Agency states that as the proposer is to pay 2000 MDkr for the hydro power, this ought to be included in the price for the plant leading to total investment needs of approximately 4000 MDkr. However, the Agency add that the operational advantages of the hydro power to the energy system are not included in this picture. On the contrary the proposer states that it is not fair to ascribe the whole investment in hydro power to the cost of the Avedøre 2 plant. The proposer emphasises that the Vattenfall agreement secures access to hydro power at a much lower cost than what would else have been possible. The proposer gives the example that if 800 GWh/year should be produced on a CC-plant in a 30 year period the value of the fuel that should be used would be more than 2000 MDkr (calculated on the basis of a real interest rate of 5%). After 2030 when the agreement about the Avedøre 2 plant runs out SK Power will still have access to 800 GWh/year of Swedish hydro power. Furthermore, if a similar CO₂ neutral capacity should be installed the investment cost for these installations would probably be several times higher.

Furthermore it has been subject to discussions whether it is possible to compare the costs of plants with different power to heat ratios. The Agency states that for the same investment it will be possible to build a CC-plant with a similar heat production and an additional electric capacity of 270 MW. This additional capacity is considered to be free of charge. On the contrary the proposer states that overall expenses of both small and major CC-plants are more expensive than the proposed plant due to the high operational expenses, i.e. the high gas price as compared to coal.

As can be seen from the description above there are many uncertainties concerning the evaluation of the proposed project. Most of these uncertainties are connected to the different incentives and lines of action of the two actors.

The approval of the second application.

31 March 1997 SK Power's revised proposal was approved by the Energy Agency. One reason for the timing of the approval was probably that, according to SK Power, Vattenfall could demand a renegotiation of the Vattenfall agreement if the plant had not been approved before 1 April 1996. The approval was given as a weighing of the following points:

- The expediency of the agreement with Vattenfall.
- Additional new electric capacity is not necessarily needed. However, the proposer is willing to scrap three old plants if the proposal is approved.
- Additional CHP capacity is needed soon after year 2000 to supply heat.
- Consideration to the biomass agreement calls for additional capacity soon after year 2000.
- The plant is needed to fulfil the national CO₂ reduction scheme.
- It is estimated that heat savings could not substitute the CO₂ effect of the plant before 2005.
- Production at the plant will lead to fuel savings in the energy system of approximately 5 PJ.
- By combining production at the plant with scrapping of old plants emissions of SO₂ and NO_x will be reduced.
- The investments for a CC-plant will be lower than of the Multi-fuel plant and the electric efficiency will be higher. However a multi fuel plant's total energy efficiency is higher and it is more flexible. Furthermore it will be easier to adapt to the gas supplier's requirements by using the multi-fuel plant leading to disengagement of gas storing capacity.

The approval was given on the condition of the fulfilment of a series of claims. Some of the most important ones are:

- The yearly use of natural gas and biomass in the plant should be at least 600 million cubic metres and 150.000 tonnes respectively.
- Facilities for desulphurization and separation of NO_x from the stack air should be added.
- Three old plants with a total production capacity of 559 MW should be scrapped when the new plant start producing at the latest.
- The proposer and ELKRAFT are obliged to secure that over capacity for heat production is not installed.
- The proposer and ELKRAFT are obliged to secure that heat savings are ascribed more attention in the planning process so that the future heat demand will be considerably lower than the heat prognosis. As a minimum the heat demand should be lower than or equal to the prognosis from "Energy 21".
- The proposer is obliged to elaborate a time schedule for scrapping of old plants.

These claims represents a new way of regulating the utilities. The utilities have never been obliged to scrap old plants or to ascribe more attention to save heat by binding the approval of a power plant to such claims. The claim to close down old plants did not come as any surprise to the proposer as they had already stated their willingness to scrap the three plants in their second application to the authorities. However, the claim on energy savings came in late in the process on the request of Elsebeth Gerner Nielsen, spokesman on environmental and energy issues for the Social-Liberal party¹⁶⁶.

The decisive difference between the approved plant and the original proposal is the use of gas in stead of coal as a fuel. Sigurd Lauge Petersen from the Agency explains it in this way: *"...our main concern has been the plant's CO₂ emissions. The CO₂ reduction that would follow from the coal fired plant was not large enough*

¹⁶⁶ Nielsen, 30.03.1997.

while the CO₂ reduction that will follow from the gas fired plant is big enough. This should be understood in this way: In the energy plan "Energy 21" we have based our calculations on the coming of a plant which is not completely identical to the approved plant, but the CO₂ reduction that follows from the plant is similar to that of the plant on which we have based our calculations. This means that the approved plant is acceptable because of its CO₂ reduction potential." The Agency sees no other way to fulfil the reduction scheme than by building the plant. All other measures would be too expensive and too long lasting to reach the short time goal in 2005.¹⁶⁷

However, in the rejection of the mainly coal fired multi-fuel concept the Agency mentions a CC-plant as the optimal choice due to its lower investments. Furthermore, facilities for desulphurisation for the plant are only necessitated by the use of oil as a reserve fuel. Therefore a plant fuelled solely by gas would have been less expensive. Sigurd Lauge Petersen from the Agency explains their change in attitude in this way: "Therefore the plant can be seen as some kind of compromise where the proposer has had the opportunity to build the plant they wanted while we have had the environmental benefits that we wanted. The same environmental benefits could have been reached for a slightly lower price if the plant was only to be natural gas fired so that the desulphurisation facility would not have been necessary to build. That would have meant that the plant could not be fired with oil. Besides the fact that the plant is slightly more expensive than it could have been I feel that we have reached the solution that we wanted."¹⁶⁸ The Agency's shift in attitude towards the multi-fuel concept can therefore be seen as a compensation given to the proposer for not being able to use coal, i.e. they can build the originally proposed multi-fuel plant without coal burners, and they are still able to change between two fuels, namely gas and oil.

Another parameter which has changed since the rejection of the first approval is the Agency's prognosis for the heat demand. In the rejection the Agency stated that there would not be heat demand in the winter 1999/2000. In the approval however it was stated that there will be a heat demand just after year 2000, i.e. in 2001. There is actually no conflict between these two statements. However the Agency has re-assessed the heat demand in the time between the two documents. In the beginning the Agency used the heat prognosis made for the energy plan "Energy 21". Since then the Agency has realised that their heat prognosis underestimated the actual heat use in 1995 and 1996 by approximately 1,5 PJ because more new customers were connected to the district heating net than expected. The Agency now expects this development to continue until year 2000 and has therefore revalued the heat demand slightly.¹⁶⁹

The definition of demand for heat delivered by CHP is not a well-defined parameter. In decentralised heat markets the Agency requires at least 90% of the heat to be delivered from CHP boilers. This claim is given to reduce the share of heat delivered by heat-only peak load boilers. In central CHP areas there is no similar concrete claim on the size of the CHP share. However, in a series of the major Danish cities the CHP share is considerably above 90%. Therefore there is no concrete claim defining when the Avedøre 2 plant is necessarily needed. The actual demand for Avedøre 2's new CHP production capacity depends on a series of parameters such as:

- Desired CHP share.
- Growth in the number of new district heating customers.
- Speed of the conversion of the old steam based heating system to low temperature heat.
- Pace of the scrapping of old production plants.
- If the H.C.Ørsted plant 7 is used for steam or low temperature production.
- Changes in heat demand of houses.
- Precedence of plants fired by gas or municipal waste.

¹⁶⁷ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

¹⁶⁸ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

¹⁶⁹ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

Therefore the evaluation whether the heat from the plant is needed is a complicated matter, involving a series of uncertain parameters. The Agency's evaluation is based on two of the proposer's heat prognosis' with differing assumptions on the speed of the conversion of the steam based system. As can be seen from the table below the CHP share is expected to be below 90% in 2000 and 2001 respectively and thereby the plant is needed.

Table 21: The Energy Agency's evaluation of the need for additional CHP production.

	Prognosis with steam conversion	Prognosis without steam conversion
Plant needed in:	2000	2001
CHP share without new plant:	87%	89-90%
CHP share in 2002 with new plant:	97-98%	99%
CHP share with new plant when Amager 1 + 2 are scrapped:	90%	94%
CHP share without new plant when Amager 1 + 2 are scrapped:	70%	74%

Source: Danish Energy Agency, "The production of district heating in Copenhagen in relation to the Avedøre 2 plant", 26.03.1997 (b).

The Agency's attitude towards the heat savings alternative.

By using the proposer's heat prognosis' the plant will be needed. However, these prognosis' are based on substantial growth in heat demand. Heat savings are not assumed to play a major role. Several opponents to the plant have claimed that substantial implementation of heat savings could substitute the need for the plant. However, Sigurd Lauge Petersen from the Agency emphasises that if heat savings should give the same CO₂ reduction as the gas fired plant, it would be necessary to totally eliminate the heat use in the greater Copenhagen area. If it had been a coal fired plant it would have been possible to obtain the same CO₂ reduction from the whole system by cutting 30% of the heat demand in Copenhagen.¹⁷⁰ Thereby the short term reduction goal for 2005 is actually a bottleneck to heat savings which are probably needed in a longer perspective to reach the long term reduction goals.

When the Energy Agency defined which alternatives the proposer ought to evaluate and compare to the originally proposed project the possibility to save heat in stead of building more production capacity was not among the alternatives defined. According to Sigurd Lauge Petersen from the Agency the problem is that the utilities are not obliged to evaluate the heat savings potential according to the law on integrated resource planning. Instead, the heat savings potential was evaluated in a report commissioned by the Agency from the Danish Technological Institute (DTI). The report from DTI assessed the cost of heat savings. The report was heavily criticised as some of the opponents to the plant felt that the investment estimates were too high. The criticism was legitimate to some extent, as it would probably be possible to implement heat savings cheaper than described in the report if the retrofitting was made when other things have to be done to the houses anyway, i.e. a lower cost could be maintained if the retrofitting are made in connection to the city renewal scheme. However then the retrofitting of houses could only be implemented at the same speed as the city renewal scheme. Sigurd Lauge Petersen from the Agency estimates that it would not be possible to stall the demand for heat if the heat savings were not implemented faster than that.¹⁷¹

Involving the public?

The procedure carried out by the Energy Agency is to a large extent assigned the general political attitude in the Parliament. The public's possibility to influence the outcome of the treatment in the Agency directly is thereby rather limited compared to the treatment carried out by the County. The EIA-procedure carried out by the County enables a more direct democratic process. However, as the County was not able or willing to evaluate the plant's expediency in relation to the overall Danish energy policy goals or to compare the plant to certain alternatives proposed by the public an important part of the decision-making process is left over to the Agency. This might not be a problem if the public was allowed insight in the Agency's treatment. However, as

¹⁷⁰ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

¹⁷¹ Interview with Sigurd Lauge Petersen from the Danish Energy Agency, 07.03.1997.

the Agency is not obliged to arrange public inquiry's or to elaborate and publicise a detailed report describing the political and technical background for the decision it becomes impenetrable to the public.

The rather short treatment process of the revised application being carried out in only 20 days did not involve the public directly at all.

Chapter 15 - The Municipality's appeal to the Appeal Board.

The Municipality's reaction to the approval.

The second application, i.e. the gas fired plant, was approved by the Danish Energy Agency 31 March 1997. The Municipality's reaction to this approval came a few days later in a press release from the Mayor. The Mayor was disappointed with the decision to approve the gas fired plant, even though it is seen as a better alternative than the coal fired version. The Mayor accuses the Danish Energy Agency's treatment for being too hasty, due to the proposer's claim that the Vattenfall agreement could not be obtained unless the plant was approved before 1 April. The Mayor is convinced that there will not be demand for the plant's heat production and that the Agency should have submitted and awaited an independent evaluation of the heat demand and possibilities to implement heat savings and renewables in stead of building the plant.¹⁷²

15 April 1997 the City Council in the Municipality of Hvidovre held a meeting where the Avedøre 2 plant was discussed. A majority in the Council was still in opposition to the plant that had been approved by the Danish Energy Agency. The Council found that it was not quite clear which assumptions and evaluations that lie behind the Danish Energy Agency's decision. Furthermore the County's environmental impact statement is claimed to be insufficient and it is proposed that a new environmental impact statement has to be made by the Danish Energy Agency. Finally the Municipality still denies to elaborate a local plan for the plant, to authorise the building work and to give permission to emit waste water from the plant to the waste water treatment plant. It is decided to proceed with the following actions:

- To take initiative to have some new alternative heat prognosis' produced.
- To address to the Minister for Environment and Energy that there are problems connected to using straw as a fuel in the plant.
- To evaluate whether the heat transmission lines have enough capacity.
- To address to the County of Copenhagen, that a new environmental impact statement has to be made.
- To address to the Minister for Environment and Energy that the Danish Energy Agency ought to carry through a new environmental impact statement.
- To continue denying to make a local plan for the plant.

The six action points were approved by a majority in the Council. However a minority consisting of the Conservative Party and the Liberal Party could not approve all the action points.¹⁷³

The Municipality's appeal to the Danish Appeal Board for Nature Protection.

20 June 1997 the Municipality of Hvidovre sent an appeal to the Danish Appeal Board for Nature Protection. The Municipality claimed that the County's treatment of the proposal to build the Avedøre 2 plant had not been carried through in a legally correct manner.

1. First of all the Municipality claimed that the County's treatment had failed to follow the procedure put out in the Danish law on planning. The three main points in the critique were:
 - a) The Municipality felt that after the proposer's first application to build a mainly coal fired plant had been rejected by the Danish Energy Agency the public, and also the Municipality, had the clear impression that the plans to build a new CHP plant at the Avedøre site had been cancelled for good. The Municipality substantiated this impression by referring to the fact that the plant was not mentioned in the County's newest regional plan proposal that had been circulated for consideration but was not yet adopted.

¹⁷² Municipality of Hvidovre, 03.04.1997.

¹⁷³ Municipality of Hvidovre, 15.04.1997.

- b) The Municipality had not been given the opportunity to comment on the County's decision to approve the gas fired version of the plant. The Municipality stated that the County should have carried through a new inquiry before finally deciding the matter.
 - c) Furthermore the Municipality felt that the application to build a mainly gas fired plant should not have been approved without elaborating a new EIS-report, due to the fact that the approved plant was not among the alternatives originally assessed in the EIS-report. The plant's use of fuel oil as reserve fuel had not been evaluated.
2. Secondly, the Municipality claimed that alternatives outside the County's geographical borders should have been evaluated in the County's environmental impact statement report. The EIA-procedure ought not to be disabled by accidental administrative borders. The European Council's Directive on EIA states that projects which leads to significant environmental impacts should in principle be subject to a systematic assessment. The County's treatment is claimed to contravene the aim of the Directive in the sense that a systematic assessment ought to evaluate the expediency of alternatives in other counties.
 3. Finally, the Municipality claimed that one of the representatives in the County's Council of politicians was disqualified to be involved in the Council's evaluation of the Avedøre 2 proposal as he was also representing the proposer through his appointment in the proposer's board of directors.¹⁷⁴

The Danish Appeal Board for Nature Protection.

Seldom ordinary courts are involved in judicial review of administrative decisions in the field of planning and environment in Denmark. Such reviews are more often carried out by independent appeal boards, which exercise court-like reviews of decisions taken by authorities in their relevant administrative areas. The Danish Appeal Board for Nature Protection is one of such Appeal Boards in Denmark.¹⁷⁵

The Danish Appeal Board for Nature Protection is part of the Ministry for Environment and Energy's system. However, the Appeal Board's functions should in principle work out independently of the Ministry. Seven out of the Appeal Board's ten members are politicians from the Parliament's Financial Committee, representing most of the political parties sitting in the Parliament. Furthermore two judges of the Supreme Court are members and the Appeal Board's chairperson is appointed by the Minister for Environment and Energy. The Appeal Board is served by a general office with 35 employees.¹⁷⁶

As mentioned in Chapter 8 objectors to a power plant project that has been approved by a County can appeal the county's decision to the Danish Appeal Board for Nature Protection, and the proposer is thereafter obliged to await the Appeal Board's decision. The Appeal Board is only authorised to evaluate whether the authorities have fulfilled their obligations in a legally correct manner, that is if the decisions have been taken in the appropriate political forum and by the appropriate legal procedure. The Appeal Board does not have the authority to evaluate the expediency of the decisions taken, even if an appeal is actually grounded in an opponent's political resistance against the project. This is due to the fact that the appeal board is not competent to challenge decisions taken by the Minister for Environment and Energy under the auspices of whom the law on planning and the law on electricity supply falls.

In cases where the Appeal Board grant an appeal the EIS-report can be disqualified if the Appeal Board estimate that the authorities' treatment has been gravely inadequate seen from a legal perspective.¹⁷⁷ In such a situation the proposer will have to await that the County elaborate a new report which is again sent out in a public inquiry process. This was what happened when the Appeal Board disqualified the County of North Jutland's decision to approve the North Jutland Power Plant without describing and assessing adequately the

¹⁷⁴ Municipality of Hvidovre, 20.06.1997.

¹⁷⁵ Kjellerup, 1998.

¹⁷⁶ Busck, 1995.

¹⁷⁷ Busck, 1995.

alternatives proposed by the public in the EIS-report (see Chapter 9 for a thorough description of the North Jutland Power Plant treatment).¹⁷⁸

Decisions stated by the Appeal Board does not only influence the specific case in question by drawing out the decision-making process. Decisions develop practices for the authorities' treatment. For example in a number of cases the decisions have developed practices for the initiation of EIA-procedures and the extension of the EIS-reports. Decentralised authorities, that is Counties and Municipalities, are obliged to consent to decisions taken by the Appeal Board, but they are able to challenge decisions of the Appeal Board in ordinary courts.¹⁷⁹ This was what happened when the Appeal Board ruled out the appeal from the Municipality of Hvidovre concerning the County's treatment of the Avedøre 2 plant: The Municipality wants to have the Appeal Board's decision verified by an ordinary court.

The Decision by the Danish Appeal Board for Nature Protection.

The Danish Appeal Board for Nature Protection forwarded the Municipality's appeal to the County, the Ministry for Environment and Energy and the Danish Energy Agency. The County rejected the two complaints first mentioned while it was admitted that one of the politicians in the County should actually have been disqualified from dealing with the case. However, as the addition to the regional plan had been agreed upon in unanimity by the members of the County Council the County did not agree that the mentioned politicians' contribution to the treatment had been of major importance. The Ministry for Environment and Energy and the Danish Energy Agency did not state any comments to the Municipality's appeal in the hearing process.

The decision by the Danish Appeal Board for Nature Protection was published 12 December 1997.

The Appeal Board stated that as the County's new proposal for a regional plan had not come into force in May 1997 when the County chose to approve the revised plant, the County's decision was legally valid as the old regional plan was still in force. The plant was part of the old plan. Furthermore as the County's approval of the revised plant did not acquire the elaboration of considerable changes to the addition to the regional plan, the Appeal Board stated that the County ought not have contacted the Municipality to make inquiry's about the Municipality's attitude to the revised plant. The Appeal Board furthermore drew attention to the fact that the lines of direction put out in the County's addition to the regional plan for the Avedøre 2 plant clearly state that the drawing up of the plant can be allowed changes as long as the environmental effects are kept below or equal to those of a coal fired plant. As the use of fuel oil is assessed to lead to fewer emissions than the use of coal the County's approval of the gas fired plant was in accordance with the lines of direction put out in the addition to the regional plan. Thereby the Appeal board refused the Municipality's request to claim the County's treatment process and the EIS-report invalid.

The Appeal Board did not give any distinct assessment whether they agree upon the Municipality's claim that alternatives outside the County's geographical borders should have been assessed more thoroughly. However the Board stated that it must be considered as doubtful, whether a sufficient assessment of alternatives outside the County's geographical borders has been made, as to fulfil the guidelines put out in the European Council's Directive on EIA. However, any possible insufficiencies concerning this matter are stated not to cause that the County's treatment should be claimed invalid. The Appeal Board substantiate this statement by claiming that the County has supported the decision not to assess alternatives outside the County's geographical borders on the Appeal Board's earlier decisions in connection to the County of North Jutland's treatment of the North Jutland Power Plant. In this earlier decision the Appeal Board stated that the County did not have to assess alternatives outside the County's own geographical borders.

Finally the Appeal Board also agreed upon the Municipality's claim that one of the politicians in the County's Council should have been disqualified from the Council's treatment of the case due to his interests in the

¹⁷⁸ Danish Appeal Board for Nature Protection, 14.09.1993.

¹⁷⁹ Kjellerup, 1998.

proposer's activities. However, the Appeal Board supports the County's own assessment that his presence has not had decisive influence on the treatment. Therefore this insufficiency in the County's treatment did not spur the Appeal Board to disqualify the County's decision or the addition to the regional plan.¹⁸⁰

Case-law developed by the Appeal Board and opponent's critique.

As explained earlier in this Chapter and in Chapter 9 the Appeal Board's decisions in connection to appeals of the counties' treatments of the proposals to build the North Jutland Power Plant and the Avedøre 2 Power Plant have developed practices for EIA-treatments in Denmark. Especially the decision that a County is not obliged to assess alternatives outside its geographical borders has been criticised by many respondents in our survey of decision-makers. The Energy Group at Aalborg University and a Danish expert in the criteria put out in the law on planning about EIA, Ulf Kjellerup, from the Danish centre of knowledge on EIA at Roskilde University have also criticised that alternatives were not evaluated thoroughly in connection to the North Jutland Power Plant treatment.

Henrik Lund and Frede Hvelplund from the Energy Group conclude that the Appeal Board's second decision concerning the North Jutland Power Plant has reduced the EIA-procedure to a troublesome piece of work focusing more at the County's geographical borders than at assessing relevant alternatives.¹⁸¹

The Municipality of Hvidovre's appeal to the Court of Justice.

The Municipality of Hvidovre has appealed the decision stated by the Danish Appeal Board for Nature Protection to the Danish Court of Justice. We have requested right of access to the documents on this matter. However, it has at the time of writing not yet been settled whether or not we can have access to the relevant information. Therefore, unfortunately, the time schedule for this report prevents a further description of the Municipality's appeal to the Court of Justice and the Court's treatment.

However, it would be of considerable interest to this case study if the Municipality's appeal cause that the case law developed by the Appeal Board will be tested in an ordinary court. Especially as the Appeal Board's statement in connection to the treatment of the Avedøre 2 plant show that the Appeal Board itself considers it as doubtful whether a sufficient assessment of alternatives outside the County's geographical borders has been made, as to fulfil the guidelines put out in the European Council's Directive on EIA

The Ministry for Environment and Energy takes over the local planning procedure.

The Municipality still denies to elaborate a local plan for the Avedøre 2 project. According to the existing local plan for the area in question a new local plan and an addition to the Municipality plan will have to be adopted before the project can be given a building permit. Therefore the Ministry for Environment and Energy has decided to take over the Municipality's legal competence to elaborate and adopt these documents. The authority to do so is constituted in the Danish law on planning, section 3, sub-section 4. An early start on the building works is considered essential for environmental and energy political reasons.¹⁸²

The Ministry published a proposal for a local plan and an addition to the Municipality plan 25 March 1998. The time limit for objections, ideas and proposals is 25 May 1998. Thereafter the Ministry will adopt the final plan.¹⁸³

¹⁸⁰ Danish Appeal Board for Nature Protection, 12.12.1998.

¹⁸¹ Lund, June 1995.

¹⁸² Danish Ministry for Environment and Energy, 15.01.1998.

¹⁸³ Danish Ministry for Environment and Energy, Department of National Planning, March 1998.

Unfortunately the time schedule for this report prevents a further description of the local planning procedure.

Chapter 16 - The County's environmental permission and the appeal.

The County's environmental permission.

The County's final environmental permission according to the regulations put out in the law on environmental protection was given 18 March 1998. The permission was based on a report describing the plant's environmental consequences and the County's assessment of those. The report describes in detail the County's specific technical conditions for giving an environmental permission. For example the County has put out claims for:

- Sulphur content in the fuel used,
- Limit values for the concentration of dust, NO_x, SO₂, CO and NH₃ in the stack air,
- Limit values for the concentration of dust, NO_x and SO₂ in the air in the local area around the plant,
- Use of ground water and desalted water from the bay,
- Instructions on treatment of waste water,
- Use of energy,
- Limit values for noise,
- Handling of ashes and residuals,
- Choice of transporting routes for heavy trucks and
- Claims for the treatment and storage of chemicals.

According to the law on environmental protection the County's decision to give an environmental permission can be appealed to the Danish Environmental Protection Agency by the proposer, the Municipality, the green organisations or anyone who has an essential interest in the outcome of the decision. Therefore the Municipality appealed the decision 15 April 1998.

The Municipality's appeal to the Danish Environmental Protection Agency.

The Municipality of Hvidovre appealed the County's environmental permission to the Danish Environmental Protection Agency 15 April 1998. The Municipality's appeal listed 10 complaints:

- The environmental permission ought not to have been given to the proposed new power plant alone. It should have been given to the existing Avedøre 1 plant and the new plant combined.
- Permission should not have been given to a gas turbine with a larger capacity than what was approved by the Energy agency.
- Permission to discharge waste water directly from the neutralisation- and sedimentation basins to the recipient should not have been given.
- Permission to discharge surface water from potentially polluted areas directly to the recipient should not have been given.
- The County ought to have claimed that a gas turbine with the lowest possible NO_x emissions is used.
- The County ought to have put out claims for the emissions of heavy metals. Furthermore heavy metals ought to be part of the control program for the plant.
- The County ought to have put out claims for the emissions of dioxins. Furthermore dioxins ought to be part of the control program for the plant.
- The County ought to have put out additional noise claims for certain areas near by the plant.
- The County ought to have put out claims for certain transport routes for heavy trucks delivering bio-fuels and fetching ashes.
- The County ought to have put out a claim that heavy trucks transporting straw is to be covered as to secure minimum nuisance.

Unfortunately the time schedule for this report prevents a further description of the Danish Environmental Protection Agency's treatment of the Municipality's appeal.

Chapter 17 - Conclusions and recommendations.

The Danish EIA-procedure.

The European Council's Directive on EIA has been integrated into the Danish law on planning. Thereby the EIA-procedure supplements the well established Danish procedure for adopting proposals to build new power plants by giving an environmental permission according to the Danish law on environmental protection and an approval according to the law on electricity supply. The permission procedures carried out by the Counties and the Danish Energy Agency according to the laws on environmental protection and electricity supply are technically expert based procedures which do not involve the public directly. By supplementing the permission procedure with the EIA-procedure the decision-making process should in principle have been improved on a number of points:

- The public is involved at an early stage of the decision-making process.
- The project is presented in a non-technical manner which allows a broad debate in society.
- As the whole planning procedure is an open process the public can better understand the Authorities' treatment.
- As all information is published the public can better understand the reasons that lie behind the Authorities' decisions.
- The objections or alternative proposals given in the public inquiry are to be integrated into the authorities' treatment and also presented in the EIS-report.
- The assessment of alternative proposals and comparison of those to the originally proposed project can lead to a better decision foundation.
- The assessment of alternative proposals can lead to other projects with lower emissions than what was originally proposed, e.g. gas in stead of coal.
- The EIA is meant to give a broader assessment, i.e. an assessment of the total environmental impacts of the project.

The Danish EIA-procedure for power plants has been entrusted the Counties. Thereby the decisions are taken close to the public in the local area. The County is responsible of elaborating the EIS-report and to describe the project and the alternatives that have been evaluated. This obligation has, in many other European countries been given to the proposer. The implementation in Denmark is thereby stronger.

The County's obligation to describe all alternatives evaluated represents a stronger implementation than in other countries. The European Council's Directive on EIA only states that the most essential alternatives that have been assessed by the proposer ought to be presented in the EIS-report. According to the Danish law on planning alternatives which have been assessed should be part of the EIA. This means that the authorities are obliged to include alternatives proposed and assessed by other actors than the proposer.

However, some problems connected to the EIA-procedure have been identified concerning the counties' treatments of both the North Jutland Power Plant proposal and the proposal to build the Avedøre 2 plant by some of the opponents to these plants. Some of the problems observed for the treatment of the North Jutland Power Plant has been solved while others are still being criticised by opponents. The most critical problems which have not yet been solved are:

- A decision from the Danish Appeal Board for Nature Protection in connection to the treatment of the North Jutland Power Plant states that the County is only obliged to evaluate alternatives within it's own regional borders. Thereby alternatives such as a major plant in another county or a mix of decentralised CHP plants in other counties combined with enhanced implementation of electricity and heat savings and increased use of renewables are left out. Thereby the EIA-procedure carried out by the County becomes in-

adequate as all the most important alternatives proposed by the public are of the kind which can not be evaluated by the County.

- The EIA-procedure carried out by the County only focuses at local environmental problems. Regional and global environmental problems as well as an evaluation of the plant's accordance to overall Danish energy policy goals are handled by the Danish Energy Agency. In this way the most important problems connected to power plants are treated by the Agency. However, the Agency's treatment is not public. The Agency is not obliged to carry out public inquiry's or to elaborate an EIS-report with an evaluation of the plant and different alternatives. Thereby the public has no guarantee that their proposals are assessed thoroughly.

Proposal for optimisation of the EIA-procedure.

Opponents to the plant propose to change the EIA-procedure in the future. The aim should be to secure that alternatives proposed by the public are assessed thoroughly as an integrated part of the EIA-procedure. This is also in line with the intentions behind the European Council's Directive on EIA. The main problem with the procedure seems to be that the County is only obliged to assess alternatives inside it's own geographical borders. Furthermore the County does not have the authority to assess the expediency of a plant proposal according to overall national energy policy goals or regional and global environmental effects. As there is general agreement among all respondents in our survey, both among opponents, proponents and authorities, that the regional and global environmental problems connected to power plants are far more severe than the local ones it seems evident that an authority which is able and willing to assess these problems is given the authority to carry out that part of the EIA-procedure.

Whether the problems are best solved by dividing the authority to carry out the EIA-procedure between the Energy Agency, the County and a group of independent experts or if it is better to leave it over to the Agency alone is an open political question which is not to be decided upon in this report. However several models could be suggested:

- The obligation to carry out the EIA-procedure could be given to the Danish Energy Agency alone.
- The obligation to carry out the EIA-procedure could be divided between the County and the Danish Energy Agency. The Agency should then assess the proposed plant according to overall national energy policy goals and the County should be obliged to evaluate local environmental problems and to give an environmental permit.
- The two models above could ideally be supplemented by giving the obligation to evaluate one or a series of alternatives to independent experts by providing funding for the work.

It seems to be of importance to present both the local, regional and global environmental problems and other parameters of interest for the decision-making process in one report, so that the basis for the decision-making process becomes more transparent to the public. Furthermore it seems evident to involve the public at an early step of the decision-making process as to secure that the public are involved in the definition of alternatives which have to be assessed and compared to the proposed project. Furthermore it might be reasonable to give financial support to independent experts for assessing alternatives to the project which are not being assessed by the proposer.

According to the law on planning it is already today possible for the Minister for Environment and Energy to overtake the EIA-procedure from the County. According to the Minister for Environment and Energy it would also be possible for a County to contact neighbouring counties to establish a co-operation with the purpose of making a more broad assessment in a geographical sense. However, in the case of power plant proposals it has not happened till now. It would therefore be necessary to change the regulations on EIA put out in the law on planning as to secure that the appropriate authority, for example the Danish Energy Agency, is entrusted the task. This could probably be done in many ways, for example by:

- Elaborating a separate law for installations with major environmental risks that are of national importance, such as major power plants. These installations are now included in the list of installations which are to be treated according to the law on planning by the counties, or by
- Establishing a preceding screening procedure where proposals are assessed by a body given the power to decide which authority that ought to carry through the procedure.

It is not the intention to decide upon which model that would be best in this report.

Finally it should be noted, that our suggestion to entrust the responsibility for the EIA-procedure to the Danish Energy Agency is based on the important claim that the Agency overtake the requirements for an open decision-making process that genuinely involves the public. The Agency should be obliged to elaborate a thorough EIS-report containing a thorough assessment and presentation of the proposed plant and relevant alternatives.

Chapter 18 - Postscript - Comparison to other European EIA studies.

It is of specific interest to the "Environmental Risk" project¹⁸⁴ to compare the case studies conducted in different countries to see if it is possible to come up with some more general conclusions on which problems that seem to be connected to the EIA-procedure and to come up with some recommendations on how the procedure can be optimised. Therefore one subtask of the project on the analysis of data from the surveys made in each country has been conducted by Simon Dresner from the University of Surrey. This analysis points out a number of general observations that can be made about the cases under study. Some of the most important are summarised here:

- Opponents almost invariably question the size of the facility, claiming that it is too large and will discourage waste minimisation and recycling (or energy efficiency in the Danish case).
- In some cases the very need for the facility is questioned.
- The choices of technology and siting are also criticised in most cases.
- There is a common complaint from opponents in all cases that the decision-making process does not genuinely involve the public.
- In some cases the decision-making process seems to many to take excessively long.
- Public inquiries are widely perceived in all countries as taking place too late in the process, when all the decisions have already been taken. As a result, they become a polarised "dialogue of the deaf" between the proposer and the opponents.
- EIA's are widely regarded as lacking credibility because they are commissioned and paid for by the proposer.
- EIA's are widely regarded as taking place too late to have any influence on the project.
- EIA's are often criticised for failing to properly consider alternatives to the proposed project.
- EIA's are often criticised for being incomprehensible to the public.
- EIA's are sometimes criticised for being too narrow and failing to take into account social and economic issues.
- Proposers who are relatively weak need to use persuasion and are open. Proposers who are very powerful can rely on coercion and manipulation.

On the basis of these general observations Simon Dresner has suggested a few points on which the EIA-procedure can generally be improved:

- Public consultation could begin much earlier in the procedure. Consultation is not a panacea, but it can prevent the debate becoming so bitter and polarised later.
- The EIA could be commissioned by a body independent of the proposer, such as the national environmental protection agency.
- The EIA could be conducted earlier in the process, consider the alternatives to the proposal, and have a summary written in language that lay-people can understand. (In Denmark a summary written in language that lay-people can understand has been elaborated)
- An analogous Social Impact Assessment could be conducted, as in the United States.

In general the four suggestions for improvements of the EIA-procedure would optimise the procedure in Denmark and are therefore relevant to present to Danish decision-makers.

Many of the general observations above indicate that the EIA-procedures in the different countries are much alike and that the problems are of a somewhat similar kind. However, for several reasons, the EIA-

¹⁸⁴ Full title: "Impact Assessment and Authorisation Procedure for Installations with Major Environmental Risks", Contract ENV4-CT96-0236 (Environmental Risk), DG XII.

procedures are probably different on many points. Therefore we have found it relevant to point out a range of examples on how the process in Denmark is probably not directly comparable to the other case studies.

In some cases more attention should be drawn to the differences that actually do exist between countries. Even though the general problems with EIA seem to be of the same kind in all countries major differences lie behind.

One difference is that the implementation of the European Council's Directive on EIA has been implemented differently in the respective countries. At least on a few crucial points the Directive has been implemented stronger in Denmark than in the other countries:

1. The obligation to evaluate alternatives to a proposal has been implemented into the Danish laws on electricity supply and planning. This means that the proposer and the County is obliged to assess alternatives and compare these to the proposed project. In this specific case the Danish Energy Agency has defined a series of alternatives which should be evaluated and compared to the proposal by the proposer. Therefore the proposer has assessed a range of supply alternatives. These have been presented and commented by the County in the EIS-report. Unfortunately the law does not oblige the proposer to assess the heat saving alternative which is preferred by many opponents to the plant. On this specific point, from an environmental point of view, the Danish law could be optimised by also securing that the heat saving alternative is assessed. The problem is somewhat similar to some of the other cases from other countries where alternatives such as waste minimisation and recycling have not been assessed thoroughly.
2. The Danish authorities are obliged by law to supervise the EIA-procedure. In most cases this is done by the local counties, but the Minister for Environment and Energy has the legal authority to take over the EIA-procedure if the proposal is somehow considered to be of national interest. The EIS-report is written by the authorities who commission sub reports containing technical evaluations of the project and alternatives to the project from the proposer. The evaluations made by the proposer are thereafter assessed by the authorities. Thereby the EIS-report is actually made in co-operation between the authorities and the proposer. In other countries the EIS-report is often conducted by the proposer alone. Clearly the proposer can often be claimed to be disqualified from conducting a reliable comparison of alternatives to his own project.
3. The Danish environmental permission procedure has been strengthened by implementing the EIA-procedure into the Danish law on planning. When the authorities are criticised for not evaluating all alternatives thoroughly it should be seen as a consequence of this strong implementation. However, there is no doubt that the number of alternatives actually evaluated in Denmark is far beyond the number of alternatives evaluated in the other cases under study.
4. In Denmark all alternatives evaluated should be presented in the EIS-report. This means that if someone else than the proposer assess and compare an alternative to the project it should also be presented in the EIS-report. However, the practical problem is often that opponents do not have sufficient knowledge and/or resources to carry out in depth assessments of alternatives. Therefore, in Denmark, one major discussion has been whether resources ought to be given to independent experts to assess the heat saving alternative thoroughly. By independent experts are meant someone who are independent of the proposer.
5. The assessment of which alternatives that can have an environmental permission is made by the authorities. Therefore, in principle the authorities have the executive power to reject the proposal if some of the alternatives are more in accordance with national policy goals. Actually this was what happened in the authorities' treatment of the Danish proposal. The Danish Energy Agency chose to reject the proposal to build a primarily coal fired plant. This forced the utility to send in a new application to build a mainly gas fired plant. Therefore, this case study is an example that environmental considerations can actually play an important role in the decision-making process. The critique of the decision to accept a gas fired plant as stated by opponents should primarily be seen as a consequence of their preferences for other alternatives such as heat and electricity savings, decentralised plants and renewables. One problem seems to be that the Danish Energy Agency's treatment process of the second application lasted less than one month

and did not involve the public at all. The process carried out by the Agency could be improved by carrying out a public inquiry process.

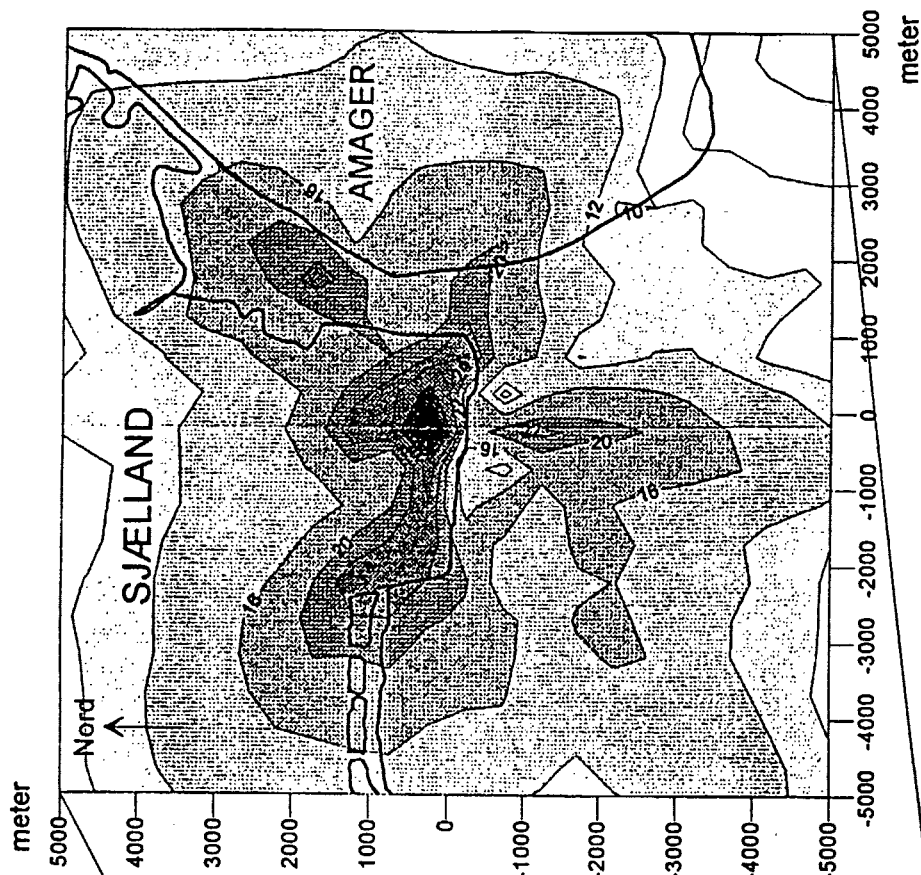
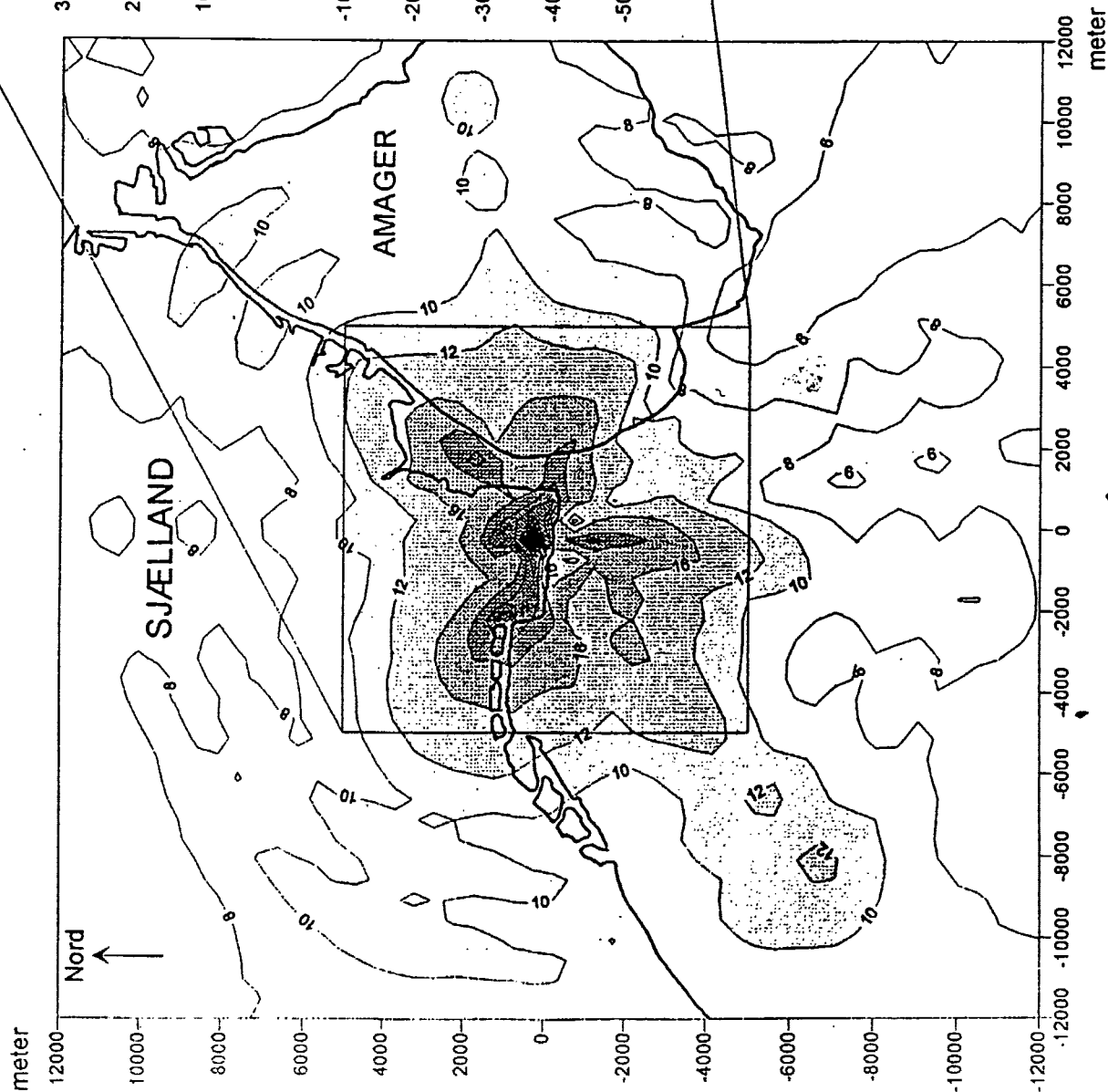
Another important difference is that the case studies deal with different types of technologies. When comparing EIA's for different technologies it seems rather important to evaluate to which extent such procedures are actually comparable. One example is that in most other countries than Denmark no or few alternatives have been evaluated. Why is that? Maybe the reason is that for power plants there are so many alternatives both considering supply and demand. For waste treatment the alternative technologies are not as technologically viable and economically sound as waste dumps or traditional waste combustion. However, a more thorough assessment of which alternatives that have been assessed, and which relevant alternatives that have not been assessed would be useful.

Furthermore there is no doubt that the level of protest in Denmark has only appeared because a coal fired power plant was proposed. Would the same level of critique have been raised in Denmark if we were dealing with a waste combustion plant? Probably not. The reason is probably that a coal fired power plant is in opposition to the national environmental policy. The proposals under study in other countries are not all of national interest as they are smaller plants and in some cases therefore less controversial.

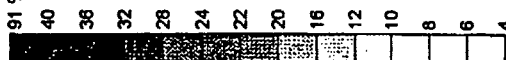
Finally it should be mentioned that when comparing case studies from different countries it is rather important to observe whether difference in public participation is due to different levels of interest, different systems for involving the public or different ways of organising public protests:

- For example, in Denmark, when considering the debate about major power plants, the public's protests have been raised by the green organisations and university professionals who are very well organised as to get their opinions through in the media and the Parliament. These opponents to the plant are very well educated and characterised by having expert knowledge about energy matters. Furthermore there is a quite strong tradition in Denmark to debate the expediency of power plants, especially coal fired ones. The opponents have learned a lot from the decision-making process in connection to earlier power plant treatments. Therefore, again, the level of public involvement might probably be quite high in Denmark in this specific case study as compared to other types of proposals in Denmark.

NO_x immissionskoncentrationsbidrag i % af B-værdien fra Avedøreværket efter idriftsættelse af AVV 2



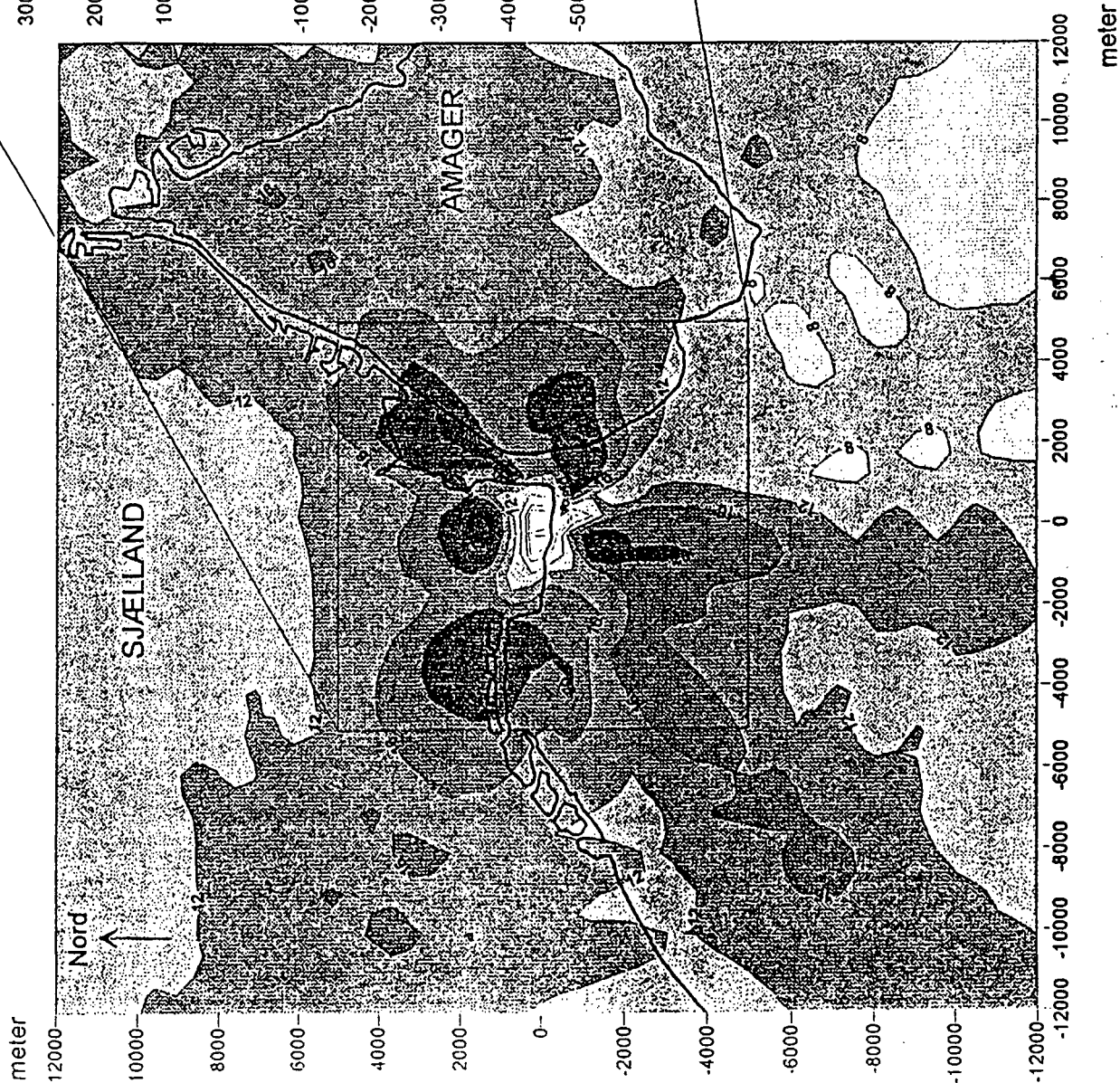
91 % af B-værdi



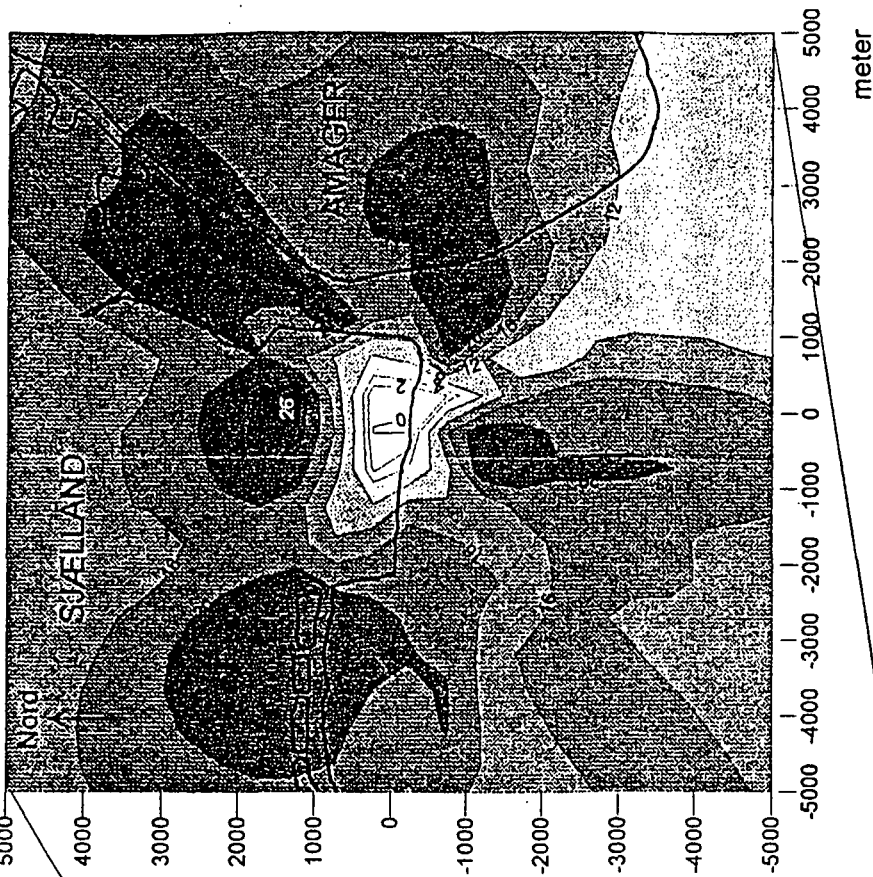
DeNOx-anlæg er i drift på begge blokke.
Halmkedel i drift. Høj NO_x fra gasturbiner.
Kurve viser NO_x-immissionskoncentrationsbidraget,
som er de højeste af 12 månedlige 99%-fraktiler
af de beregnede timemiddelværdier i 3240 punkter
rundt om værket.

Højeste værdi er 91 % af det maksimale
tilladte bidrag fra virksomheden (B-værdien).
Dette svarer til 114 µg/m³. Maksimum falder
i den nordlige del af værket område.

SO₂ immissionskoncentrationsbidrag i % af B-værdien for Avedøreværket efter idriftsættelse af AVV 2



meter



28 % af B-værdi



Afsøvingsanlæg er i drift på begge blokke.

Halmkedel i drift.

Kurverne viser SO₂-immissionskoncentrationsbidraget, som er de højeste af 12 månedlige 99%-fraktiler af de beregnede timemiddelværdier i 3240 punkter rundt om værket.

Højeste værdi er 28 % af det maksimalt

tilladelige bidrag fra virksomheden (B-værdien).

Dette svarer til 71 µg/m³. Maksimum falder

1500 meter fra værket i nordlig retning.

meter

Chapter 20 - Words, concepts, names and abbreviations.

Avedøre 1: The Avedøre 1 plant is a CHP plant situated in Avedøre in the west part of the Greater Copenhagen area. The plant started producing in 1990 and is similar to the Amager 3 plant which started production in 1989. Avedøre 1 is owned by SK Power.

Avedøre 2: The plant that is proposed to be built by SK Power. The plant is based on a so called multi-fuel concept allowing use of both oil, gas, coal and biomass. The plant was originally envisaged to be mainly coal fired. However the Authorities turned down this application. In stead a mainly gas fired version has been approved. The plant is to be owned by SK Power and a Swedish energy company, Vattenfall. Vattenfall will own 40% of the plant's electric capacity.

Biomass Agreement: An agreement made by a broad majority in the Danish Parliament in 1993 which put out an injunction to the utilities to use a certain amount of biomass before year 2000 at the latest.

Centre Democrats' Party: One of three small political parties in the Parliament placed in the centre politically speaking. The party can be placed somewhere between the Social Democrats and the Conservatives. When the application to build the coal fired plant was sent in the party formed government together with the Social Democrats and the Social-Liberal Party. The Centre Democrats were in favour of a mainly coal fired plant and were therefore disappointed that the Minister for Environment and Energy rejected the first application. The party left the government before the decision was taken to approve the gas fired plant.

CHP: Combined Heat and Power.

Christians' Party: One of three small political parties in the Parliament placed in the centre politically speaking. The party can be placed somewhere between the Social Democrats and the Conservatives. The Christians leader, Jann Sjursen, was Minister for Environment and Energy until September 1994 when the party left the Parliament due to a bad result at the election. Therefore the party was not in Parliament during the time where the plant proposal was treated.

Combined Cycle plant (CC-plant): A gas turbine allowing part of the heat in the stack gas to be recovered for energy production.

Conservative Party: A liberal party which is traditionally in favour of coal fired plants.

County of Copenhagen: The County of Copenhagen is placed in the west part of the greater Copenhagen area. The County was responsible for the EIA-procedure for the proposed plant.

Coupled gas turbines: An alternative to the Avedøre 2 project which has been evaluated by the proposer. The concept is to add gas turbines to existing major power plants in the greater Copenhagen area, thereby being able to produce at a high electric efficiency and to use the residual stack gas for heating the feeding water for the boiler at the existing plant.

CTR: Metropolitan Copenhagen Heat Transmission Company, serving central Copenhagen.

DANGAS: The Danish gas supplier which among other things deliver gas to the regional gas distributing companies and to major customers like for instance power plants and which export gas to Sweden and Germany. DANGAS is owned by DONG, which is owned by the Danish state. The Minister for Environment and Energy is sole shareholder.

Danish Appeal Board for Nature Protection: The Danish Appeal Board for Nature Protection is part of the Ministry for Environment and Energy's system. However, the Appeal Board's functions should in principle work out independently of the Ministry. Seven out of the Appeal Board's ten members are politicians from the Parliament's Financial Committee, representing most of the political parties represented in the Parliament. Furthermore two judges of the Supreme Court are members and the Appeal Board's chairman is appointed by the Minister for Environment and Energy. The Appeal Board is served by a general office with 35 employees.

Danish Energy Agency: The Agency is part of the Ministry for Environment and Energy and serves the Minister for Environment and Energy. Important for this case study is that the Agency treat applications to

build power plants and manage the regulation of the power sector decided upon by the Parliament. Among other things the Agency regulate the utilities' emissions to the air.

Danish Environmental Protection Agency: The Agency is part of the Ministry for Environment and Energy and serves the Minister for Environment and Energy. Important for this case study is that the Agency puts out immission values for power plants.

DEA: See Danish Energy Agency.

DTI: Danish Technological Institute. The institute carried out the evaluation of the heat saving potential.

Ecological Council: Co-operated with the other green organisations to stop the coal fired plant.

EIA: Environmental Impact Assessment

EIS-report: Environmental Impact Statement report.

ELKRAFT: An umbrella organisation for all power producers in West Denmark.

ELSAM: An umbrella organisation for all power producers in East Denmark.

ENERGY 2000: The Danish Government's Energy Plan from 1990.

Energy 21: The Danish Government's latest Energy Plan from 1996.

Energy Group at the University of Ålborg: A group of social scientists employed at the University of Ålborg. The group has been opponents to the development with major power plants. They are in favour of decentralised CHP plants and renewables mainly due to their better environmental performance.

Energy Movement: Co-operated with the other green organisations to stop the coal fired plant.

Government: The recent Government is formed by the Social Democrats' Party and the Social-Liberal Party. At the time when the plant was approved the same two parties formed government. At the time when the first application was sent in until after the coal fired version of the plant was rejected the Government was formed by the Social Democrats, the Social-Liberal Party and the Centre Democrats' Party.

Greenpeace Denmark: Co-operated with the other green organisations to stop the coal fired plant.

HNG: The Metropolitan Copenhagen gas Distribution Company.

IRM: Integrated Resource Management.

KB Energy: A vertically integrated energy company which own three major CHP plants in the greater Copenhagen area and part of the distribution system for heat and electricity. Furthermore owns 20% of ELKRAFT. KB Energy is owned by the Municipality of Copenhagen.

Left Wing Coalition: A political party more to the left than the Socialists', politically speaking. The Party is traditionally against any more coal fired plants. Prefer intensified use of renewables and energy savings.

Liberal Party: A liberal party which is traditionally in favour of coal fired plants.

Minister for Environment and Energy: Since September 1994 the Ministries for Environment and Energy have been put together with the Social Democrat Svend Auken in office. Before that Jann Sjørnsen from the Christian Party was Minister for Energy. At the time when the North Jutland Power Plant was approved Anne Birgitte Lundholt from the Conservative Party was Minister for Energy.

Ministry for Environment and Energy: The ministries for Environment and Energy were put together in September 1994.

Multi-fuel concept: The Avedøre 2 plant is planned to be based on a so called multi-fuel concept. By using a boiler which is fit for using oil, coal and gas and by adding a gas turbine and a biomass boiler, it becomes possible to use a range of different fuels and to shift between these.

Municipality of Hvidovre: The Municipality in which the Avedøre 2 plant is to be situated. The Municipality is strongly in opposition to the plans to build the plant.

No_x-quotas: Quotas are put out for the total Danish emissions to the air. Furthermore the utilities are given injunctions for certain quotas which have to be fulfilled by the Danish Energy Agency. The quotas are distributed between the utilities by the utilities' two umbrella organisations ELSAM and ELKRAFT.

Organisation for Preservation of Nature: The biggest Danish green non-governmental organisation which co-operated with the other green organisations to stop the coal fired plant.

Parliament's Council on Technology Evaluations: The Council is a body independent of the Parliament and the ministries. February 1996 the Council carried out an expert hearing on the expediency of the Avedøre 2 plant. The result was a list with interesting questions that ought to be dealt with in the Parliament's treatment of the proposal. The Council was requested to carry through the expert hearing by Elsebeth Gerner Nielsen from the Social-Liberal Party.

Parliament's Energy Political Committee: The Committee is composed of representatives for a range of political parties represented in the Danish Parliament. Among other things the Committee have raised a series of questions to the Minister for Environment and Energy concerning the Avedøre 2 plant. The minister's answers to these questions are often used when the authorities are to interpret the exact meaning and purpose of different laws.

Proposer: See SK Power.

SK Power: The proposer of the Avedøre 2 plant. SK Power is the major energy company in west Denmark, owning the Avedøre 1 power plant and additionally all the major power plants outside the Copenhagen area and some of the minor ones too. Furthermore owns 80% of ELKRAFT. SK Power is a joined stock company namely owned by distributors. Main part of the stocks in the distributors' companies are owned by municipalities.

SO₂-quotas: Quotas are put out for the total Danish emissions to the air. Furthermore the utilities are given injunctions for certain quotas which have to be fulfilled by the Danish Energy Agency. The quotas are distributed between the utilities by the utilities' two umbrella organisations ELSAM and ELKRAFT.

Social Democrats' Party: The biggest political party in the Danish Parliament. The Social Democrat's approved the coal fired North Jutland Power Plant, but rejected the proposal to build the Avedøre 2 plant as a mainly coal fired plant. The party is known to be divided on the question whether coal should be used as a fuel. However, recently the Social Democrats who now form government together with the Social-Liberal Party have declared a coal stop, i.e. that no more coal fired power plants should be built in Denmark.

Social-Liberal Party: One of the rather small political parties in the Parliament which is politically speaking placed at the centre. The Social-Liberals form government together with the Social Democrats Party. The party is known to be against coal fired plants, and has, together with the Social Democrats decided to declare a coal stop, i.e. that no more coal fired power plants should be built in Denmark.

Socialists' Party: A political party more to the left than the Social Democrat's, politically speaking. The Party is traditionally against any more coal fired plants. Prefer intensified use of renewables and energy savings.

Summer time gas: The natural gas can be rendered cheaper in the summer time as the demand is lower. Therefore the proposer prefer to use more gas in the summertime.

Status Quo alternative: The proposer's status quo alternative is not a fixed picture, i.e. what will happen if nothing is changed at all. The status quo alternative include that the Avedøre 2 is not built, but growing use of biomass, wind power and decentralised CHP, fulfilment of quotas for NO_x and SO₂, electricity savings, growth in heat demand, etc. i.e. the status quo alternative is a dynamic picture of what will happen if the Avedøre 2 is not built.

Vattenfall: A Swedish power producer. Vattenfall owns shares in SK Power's biggest stock holder, the distributing company NESA.

Vattenfall agreement: Vattenfall has made an agreement with SK Power which secure the company an owner share of 40% of the Avedøre 2 plant's electricity production and access to transmit electricity from Zealand to Germany through SK Power's KONTEK sea cable. In return SK Power gets access to 200MW electric capacity in a Swedish hydro power plant.

VEKS: Heat transmission company serving west Copenhagen.

Zealand: East part of Denmark.

Chapter 21 - Literature

- Andersen, Anders N.**, "Letter to the County of North Jutland with comments to the EIA-procedure concerning the North Jutland Power Plant", **18.02.1993**.
- Auken, Svend**, Danish Minister for Environment and Energy, "Denmark phases out coal", Article in "Canberra Times", Australia, **17.06.1997**, in English.
- Auken, Svend**, Danish Minister for Environment and Energy, "Denmark as a pioneer country concerning liberalisation of the electricity sector", Article in "Ugebladet Mandag Morgen", **23.06.1997**, in Danish.
- Auken, Svend**, Danish Minister for Environment and Energy, "The future of wind turbines lies at sea", newspaper article in "Berlingske Tidende", **17.07.1997**, in Danish.
- Auken, Svend**, Danish Minister for Environment and Energy, "Kyoto, the climate and the struggle", Article in "Socialdemokraten", **15.12. 1997**, in Danish.
- Busck, Lars**, Chairman of the Danish Appeal Board for Nature Protection, "The Danish Appeal Board for Nature Protection", Article in "Byplan", vol. 5, **1995**, in Danish.
- Bøckmann, Claus et. al.**, "EIA - from project to plan", Institute for Environment, Technology and Society, Roskilde University, Denmark, **1993**, in Danish.
- Christensen, Britta**, Mayor of the Municipality of Hvidovre, "Natural not to build an additional power plant", newspaper article in "Hvidovre Avis", **27.02.1994**, in Danish.
- Clausen, Sejr**, "NESA on Danish hands - the money are missing", newspaper article in "Berlingske Tidende", **02.11.1996**, in Danish.
- Council Directive** of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment **85/337/EEC, 1985**, in English.
- Council Directive 97/11/EC** of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, **1997**, in English.
- County of Copenhagen**, "Letter to Greenpeace Denmark from the County of Copenhagen", **19.04.1995**, in Danish.
- County of Copenhagen**, "Amendment to the Regional plan number 6: Inquiry of ideas, propositions etc. Avedøre 2 - environmental impact statement", **May 1995**, in Danish.
- County of Copenhagen**, "Summary of the ideas and propositions formulated in the inquiry process of the amendment to the regional plan number 6", **25.10.1995**, in Danish.
- County of Copenhagen**, "Amendment to the regional plan number 6: The Avedøre 2 Plant - Environmental impact statement", **January 1996 (a)**, in Danish.
- County of Copenhagen**, "Summary of the amendment to the regional plan number 6: The Avedøre 2 Plant - Environmental impact statement", **January 1996 (b)**, in Danish.
- County of Copenhagen**, "Proposal for an environmental approval of the Avedøre 2 Plant", **January 1996 (c)**, in Danish.
- County of Copenhagen**, "Proposal for an amendment to the regional plan for the Avedøre 2 Plant - Evaluation of the comments given in the public inquiry process", **June 1996**, in Danish.
- County of Copenhagen**, "Final approval of the amendment to the regional plan for the Avedøre 2 plant", **18.06.1996**, in Danish.
- County of Copenhagen**, "Evaluation of the Avedøre 2 plant which was approved by the Danish Energy Agency compared to the plant evaluated in the EIS-report", **17.04.1997**, in Danish.
- County of Copenhagen**, "Approval of the proposal for an amendment to the regional plan for the Avedøre 2 plant", **21.05.1997**, in Danish.
- County of Copenhagen**, "Letter to the Danish Appeal Board for Nature Protection with comments to the Municipality of Hvidovre's appeal concerning the regional planning procedure", **01.09.1997**, in Danish.
- County of Copenhagen**, "Memorandum concerning the Municipality of Hvidovre's comments to the proposal for an environmental permission for the Avedøre 2 plant", **17.10.1997**, in Danish.
- County of Copenhagen**, "Letter to the Danish Appeal Board for Nature Protection with additional comments to the Municipality of Hvidovre's appeal concerning the regional planning procedure", **27.10.1997**, in Danish.
- County of Copenhagen**, "Letter to the Municipality of Hvidovre commenting the Municipality's letter from 16.02.1998", **20.02.1998**, in Danish.
- County of Copenhagen**, "Environmental approval - Avedøre 2", **18.03.1998**, in Danish.
- County of North Jutland**, "Letter to the Danish Appeal Board for Nature Protection", **17.02.1993**, in Danish.
- County of North Jutland**, "Amendment no.26 to the regional plan including an Environmental impact statement", **April 1994**, in Danish.
- County of North Jutland**, "Environmental approval of the North Jutland Power Plant", **April 1994**, in Danish.

- Danish Appeal Board for Nature Protection**, "Decision to the appeal in connection to the amendment to the regional plan concerning the North Jutland Power Plant", **14.09.1993**, in Danish.
- Danish Appeal Board for Nature Protection**, "Decision to the appeal in connection to the amendment to the regional plan concerning the North Jutland Power Plant", **11.04.1994**, in Danish.
- Danish Appeal Board for Nature Protection**, "Decision to the appeal in connection to the amendment to the regional plan concerning the Avedøre 2 Plant", **12.12.1997**, in Danish.
- Danish Council for Energy and Environment**, "Study of subsidies for renewable energy", **March 1998**, in Danish.
- Danish Energy Agency**, "Energy 2000", **1990**, in Danish and English.
- Danish Energy Agency**, "Report on the organisation of Danish energy companies", **1991**, in Danish.
- Danish Energy Agency**, "Decision according to the law of energy supply of the proposal to build two major plants for electricity production Skærbækværket and Vendsysselværket (Nordjyllandsværket)", **03.04.1992**, in Danish.
- Danish Energy Agency**, "District Heating in Denmark - Research and Technological Development", **1993**, in English.
- Danish Energy Agency**, "Report on the demand for CHP in the greater Copenhagen area", **15.03.1994**, in Danish.
- Danish Energy Agency**, "Letter to SID", **17.11.1994**, in Danish.
- Danish Energy Agency**, "Letter to the Organisation for Preservation of Nature", **14.12.1994 (a)**, in Danish.
- Danish Energy Agency**, "Letters to SID, Greenpeace and Ingeniøren", **14.12.1994 (b)**, in Danish.
- Danish Energy Agency**, "Energy statistics 1995", **1995 (a)**, in Danish and English.
- Danish Energy Agency**, "Avedøre 2 - Evaluation of the demand and environmental performance", **24.06.1996**, in Danish.
- Danish Energy Agency**, "Comments to SK Power's comparison of investments connected to different Avedøre 2 plant concepts", **25.06.1996**, in Danish.
- Danish Energy Agency**, "Decision according to the law on electricity supply of SK Power's application to build Avedøre 2", **28.06.1996**, in Danish.
- Danish Energy Agency**, "CO₂ reduction of the Avedøre 2 plant", **26.03.1997 (a)**, in Danish.
- Danish Energy Agency**, "The production of district heating in Copenhagen in relation to the Avedøre 2 plant", **26.03.1997 (b)**, in Danish.
- Danish Energy Agency**, "Decision according to the law on electricity supply of SK Power's revised application to build Avedøre 2", **31.03.1997**, in Danish.
- Danish Environmental Protection Agency**, "Handbook from the Danish Environmental Protection Agency - Reduction of air pollution from industry", **1990**, in Danish.
- Danish Environmental Protection Agency**, "Working report from the Danish Environmental Protection Agency - Handbook for environmental impact auditing for power plants", **1996**, in Danish.
- Danish Ministry for Environment and Energy**, "Departmental order no. 689 15 October 1990 for reduction of emissions of SO₂ and NO_x and dust from major combustion plants - as changed with departmental order no. 518 20 June 1995", **15.10.1990**, in Danish.
- Danish Ministry for Environment and Energy**, "Departmental order no. 688 15 October 1990 for limitation of emissions of NO_x etc. from gas fuelled engines and turbines", **15.10.1990**, in Danish.
- Danish Ministry for Environment and Energy**, "Departmental order no. 885 18 December 1991 for reduction of emissions of SO₂ and NO_x from power plants", **18.12.1991**, in Danish.
- Danish Ministry for Environment and Energy**, "Departmental order no. 901 31 October 1994 for limitation of the sulphur content in fuel for combustion and transport purposes", **31.10.1994**, in Danish.
- Danish Ministry for Environment and Energy**, "Guidance on procedures for environmental assessments of bills and other Government proposals", **March 1995**, in English.
- Danish Ministry for Environment and Energy**, "Letter from the Minister for Environment and Energy, Svend Auken, to the Ecological Council", **06.06.1995 (a)**, in Danish.
- Danish Ministry for Environment and Energy**, "Letter from the Minister to the Mayor of the County of Copenhagen", **06.06.1995 (b)**.
- Danish Ministry for Environment and Energy**, "Letter from the Minister for Environment and Energy, Svend Auken, to Greenpeace Denmark", **30.06.1995**, in Danish.
- Danish Ministry for Environment and Energy**, "Environmental Impact Assessment - an introduction to the law on EIA", **1995 (a)**, in Danish.
- Danish Ministry for Environment and Energy**, "Energy 21 - the Government's action plan 1996", **1996 (a)**, in Danish and English.
- Danish Ministry for Environment and Energy**, "Written notice from 16 April 1996 about the Government's energy plan "Energy 21", no. R 16, **1996 (B)**, in Danish.

- Danish Ministry for Environment and Energy**, "Press release: No to new Avedøre 2 power plant partly based on coal", **28.06.1996**, in Danish.
- Danish Ministry for Environment and Energy**, "Guidance on the law on planning", **November 1996**, in Danish.
- Danish Ministry for Environment and Energy**, "Departmental order on procedure for the Danish Appeal Board for nature protection, no. 720, **September 1997**, in Danish.
- Danish Ministry for Environment and Energy**, "Letter to the Parliament's Energy Political Committee with an announcement that the Ministry call in the Municipality's obligation to carry through the local planning procedure", **January 1998**, in Danish.
- Danish Ministry for Environment and Energy**, "Letter to the Municipality of Hvidovre's city council with an announcement that the Ministry call in the Municipality's obligation to carry through the local planning procedure, **15.01.1998**, in Danish.
- Danish Ministry for Environment and Energy**, Department of National Planning, "Proposal for a local plan and an amendment for the Municipality's plan for an extension with an additional plant in Avedøre in the Municipality of Hvidovre", **March 1998**, in Danish.
- Danish Ministry for Environment and Energy**, "Report on Danish energy policy for the Danish Parliament's Committee on energy issues", **02.04.1998**, in Danish.
- Danish Ministry for Transport**, "The Government's action plan for reducing the emissions of CO₂ from the Danish transport sector", **1996**, in Danish.
- Danish Parliament**, "Debate on renewal of the electricity production system, possibilities to save electricity and possibilities to use renewable energies", p. 7369-7436, **10.03.1992**, in Danish.
- Danish Parliament**, "Agreement between the Government, the Conservatives, the liberals and the Socialists about increasing use of biomass for energy- and industrial purposes", **14.06.1993**, in Danish.
- Danish Parliament**, "Written account of the negotiations in the Danish Parliament about the Government's energy plan "Energy 21" on the 30'th of April 1996", number R 16, **1996**, in Danish.
- Danish Parliament**, the Energy Political Committee, "Report concerning a proposal to an amendment to the law on electricity supply, No. L68", **22.01.1998**, in Danish.
- Danish Parliament**, the Energy Political Committee, "Letter to ELSAM, ELKRAFT and ELTRA concerning implementation of 750 MW wind turbine capacity at sea", **13.02.1998**, in Danish.
- Ecological Council**, "Letter to the Minister for Environment and Energy", **24.04.1995**, in Danish.
- ELKRAFT**, "Plan 92/93", **1993 (a)**, in Danish.
- ELKRAFT**, "Electricity prognosis 1993-2015", **1993 (b)**, in Danish.
- ELKRAFT**, "Extension of the decentralised CHP system in the ELKRAFT area, **1993 (c)**, in Danish.
- ELKRAFT**, "The heat demand in the greater Copenhagen area", **1993 (d)**, in Danish.
- ELKRAFT**, "Plan 94", **1994 (a)**, in Danish.
- ELKRAFT**, "CO₂-initiatives in Denmark and other countries", **1994 (b)**, in Danish.
- ELKRAFT**, "Account of the meeting 25 April at ELKRAFT concerning the procedure for the authorities' treatment of Avedøre 2", **27.04.1994**, in Danish.
- ELKRAFT**, "Account of the meeting 20 June at the Danish Energy Agency concerning electricity savings in connection to the authorities' treatment of Avedøre 2", **04.07.1994**, in Danish.
- ELKRAFT**, "Plan 95", **1995 (a)**, in Danish.
- ELKRAFT**, "Annual report 1995", **1995 (b)**, in Danish.
- ELKRAFT**, "The Multi-fuel plant", **1995 (c)**, in Danish and English.
- ELKRAFT**, "Evaluation of Avedøre 2 and alternatives to Avedøre 2 - main report", **1995 (d)**, in Danish.
- ELKRAFT**, "Evaluation of Avedøre 2 and alternatives to Avedøre 2 - amendment report", **1995 (e)**, in Danish.
- ELKRAFT**, "Energy plan 95", newspaper from ELKRAFT, **March 1996 (a)**, in Danish.
- ELKRAFT**, "Energy and environment in east Denmark", **1996 (b)**, in Danish.
- ELKRAFT**, "Comments to the Energy Agency's note considering investment costs for the Avedøre 2 power plant dated 24.06.1996", **25.06.1996**, in Danish.
- ELKRAFT**, "IRP 1997, the ELKRAFT co-operation's integrated resource plan", **January 1998**, in Danish.
- Elling, Bo**, "The environment and the directive on environmental impact assessment of major installations", Article in "Samfundsøkonomen", vol. 3, **1994**, in Danish.
- Elling, Bo**, "EIA in practice", Article in "Byplan", vol.23, **1995**, in Danish.
- Elling, Bo and Jane Nielsen**, "Environmental assessment of regional plans", TemaNord 1996:602, Knowledge Center for Environmental Assessment, Institute for Environment, Technology and Society, Roskilde University, **1996**, in Danish.
- Energy Movement**, Letter to Martin Glerup", **03.04.1995**.
- Energy Movement**, "Letter to the County of Copenhagen", **30.8.1995**, in Danish.
- Erhardtson, Birgitte**, "Billion-contracts for Danish companies", newspaper article in "Børsen", **09.11.1995**, in Danish.

- European Commission**, DG XI, L. Krämer, "Letter: Concerning the interpretation of the EIA-directive", **06.01.1993**, in Danish.
- Government notice** of a protocol from 9 July 1985 to the convention from 13 November 1979 about borderless air pollution over large distances dealing with reduction of emissions of sulphur, BKI no. 107, **15.12.1987**, in Danish.
- Government notice** on the law on electricity supply, LBK No. 632, **01.07.1996**, in Danish.
- Government notice** on Environmental Impact Statement for major installations, no. 446, **23.06.1989**, in Danish.
- Government notice** on the law on planning, Bek. no. 903, **17.12.1991**, in Danish.
- Government notice** on the law on planning, Bek. no. 847, **30.09.1994**, in Danish.
- Greenpeace Denmark**, the Organisation for Preservation of Nature, the Energy Movement, the Organisation for renewable energy, the Ecological Council, Henrik Lund (University of Aalborg) and Frede Hvelplund (University of Aalborg), "Letter to the Minister for Environment and Energy, Svend Auken", **31.03.1995**, in Danish.
- Greenpeace Denmark**, "Letter to the County of Copenhagen", **30.8.1995**, in Danish.
- Hansen**, Per Henrik, "Auken says no to coal powered power plants in the future", Newspaper article in "Information", **12.03.1997**, in Danish.
- Henriksen**, Kurt, "Swedes wants to conquer the Danish market for electricity", newspaper article in "Børsen", **03.09.1996**, in Danish.
- Henriksen**, Kurt, "The Municipality of Gentofte hold the golden key to the electricity market", newspaper article in "Børsen", **17.05.1996**, in Danish.
- Holdum**, Rie, "The Liberal's and the Conservatives': Coal stop induces more pollution", Newspaper article in "Information", **13.03.1997**, in Danish.
- KB Energy**, "Annual report '95 - and environmental impact statement for the CHP plants", **1995**, in Danish.
- KB Energy**, "The electricity plants in Copenhagen 1892-1992", **1992**, in Danish.
- Kjellerup**, Ulf, "legality/ and/or legitimacy", Essay in the newspaper "Information", **16.08.1994**, in Danish.
- Kjellerup**, Ulf, "The project conception in the Directive on EIA", printed in "The North and the European Council Directive on EIA", Tema Nord, The Nordic Council of Ministers, no. 570, **1995**, in Danish.
- Kjellerup**, Ulf, "The Minister for Environment the only one to be blamed", Essay in the newspaper "Information", **August 1994**, in Danish.
- Kjellerup**, Ulf, "Significance interpretation in the legal-review system", Printed in "Nordic Newsletter on EIA", no.8., **December 1997**, in English.
- Kjellerup**, Ulf, "Significant Impacts" as a decisive criterion in the legal system in Denmark", to be published in "EIA-Review" during spring/summer **1998**, in English.
- Krohn**, Søren, Managing Director, "Danish Wind Turbines: An Industrial Success Story", Danish Wind Turbine Manufacturers Association, **1997**, in English.
- Krüger**, "Concerning Avedøre 2", **07.04.1995**, in Danish.
- law on amendment of the law on electricity supply (integrated resource management), **09.02.1994**, in Danish.
- Law on planning**, Notice no. 563, **30.06.1997**.
- Law on subsidies for electricity production**, **27.12.1994**, in Danish.
- Law on amendment of the law on electricity supply** (Payment for electricity produced on decentralised CHP plants etc.), **20.12.1995**, in Danish.
- Lund**, Henrik, Frede Hvelplund, Klaus Illum and Henning Mæng, Institute for Society's Development and Planning at University of Aalborg, "Danish energy policy and ELSAM's expansion plans - a proposal to a public debate", **November 1991**, in Danish.
- Lund**, Henrik and Frede Hvelplund, Institute for Society's Development and Planning at University of Aalborg, "Report describing two alternatives to the North Jutland Power Plant sent to the County of North Jutland", **07.05.1992**, in Danish.
- Lund**, Henrik and Frede Hvelplund, Institute for Society's Development and Planning at University of Aalborg, "Letter with an appeal to the Minister for Environment and Energy", **18.12.1992**, in Danish.
- Lund**, Henrik and Frede Hvelplund, Institute for Society's Development and Planning at University of Aalborg, "Public regulation and alteration of technological course - case study of the North Jutland Power Plant", University of Aalborgs publishing firm, **January 1994**, in Danish.
- Lund**, Henrik and Frede Hvelplund, Institute for Society's Development and Planning at University of Aalborg, "Danish EIA regulations makes environmental assessment of power plants impossible", article printed in "Nordisk Nyhedsbrev om vurdering af virkninger på miljøet, no. 5.", **June 1995**, in Danish.
- Lund**, Henrik and Frede Hvelplund, Institute for Society's Development and Planning at University of Aalborg, "Democracy and change - Energy action plan 96", series of energy, Aalborg University Publishing Firm, **1995**, in Danish.

- Lund, Henrik and Frede Hvelplund**, Institute for Society's Development and Planning at University of Aalborg, "Democracy and change", Article in "Vedvarende Energi og Miljø", Vol 1, **1996 (a)**, in Danish.
- Lund, Henrik and Frede Hvelplund**, Institute for Society's Development and Planning at University of Aalborg, "Democracy and change - also in the energy sector", Article in "El og Energi", Vol 1, **1996 (b)**, in Danish.
- Lund, Henrik**, Institute for Society's Development and Planning at University of Aalborg, "Elements for a green energy plan creating jobs", Published by Danish Special Workers' Federation (SID), **March 1996**, in Danish.
- Municipality Council of Copenhagen**, "Authorisation to the Council's representatives in ELKRAFT's board of directors to accept SK Power's application", **16.06.1994 (a)**, in Danish.
- Municipality Council of Copenhagen**, "Authorisation to the Council's representatives in ELKRAFT's board of directors to accept SK Power's agreement with Vattenfall, **16.06.1994 (b)**, in Danish.
- Municipality of Hvidovre**, "Report to the Municipality's Council from the Municipality's Technical Department about the Avedøre 2 project", **21.02.1995**, in Danish.
- Municipality of Hvidovre**, "Letter to the Union SID commenting the Union's apply for money to develop alternatives to the Avedøre 2 project", **08.03.1995**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the County of Copenhagen", **21.03.1996 (a)**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the Minister for Environment and Energy", **21.03.1996 (b)**, in Danish.
- Municipality of Hvidovre**, "Press release: Britta Christensen still recommend a rejection of Avedøre 2 plant", **03.04.1997**, in Danish.
- Municipality of Hvidovre**, "Account of the Municipality Council's meeting 15.04.1997", **15.04.1997**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the Danish Appeal Board for Nature Protection with appeal concerning the County's regional planning procedure", **20.06.1997**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to County of Copenhagen with temporary technical comments to a proposal for an environmental permission to the Avedøre 2 plant", **18.09.1997**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the Danish Appeal Board for Nature Protection with additional statements concerning the County's regional planning procedure", **06.10.1997**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the Danish Appeal Board for Nature Protection with additional statements concerning the County's regional planning procedure", **11.11.1997**, in Danish.
- Municipality of Hvidovre**, "Letter from the Municipality of Hvidovre to the County of Copenhagen with comments to the County's latest proposal for an environmental approval", **16.02.1998**, in Danish.
- Municipality of Hvidovre**, "Appeal of the County's environmental permission for Avedøre 2 to the Danish Environmental Protection Agency", **15.04.1998**, in Danish.
- Nielsen, Elsebeth Gerner**, Member of the Danish Parliament for the Social-Liberal Party, "Letter to the Minister for Environment and Energy, Svend Auken with suggestions for claims which should be connected to the approval of the Avedøre 2 plant", **31.03.1997**, in Danish.
- Nielsen, Jørgen Steen**, "European Union's internal market blocks debate about new power plant", newspaper article in "Information", **07.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "Electric utility: Openness oust us", newspaper article in "Information", **08.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "Environmental data for coal powered plant released", **15.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "Environmental juridical expert: ELKRAFT will have to deliver data for the environmental impacts of the Avedøre 2 plant", newspaper article in "Information", **12.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "No environmental inquiry process now", newspaper article in "Information", **14.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "Auken enters treatment of application to build power plant", newspaper article in "Information", **17.12.1994**, in Danish.
- Nielsen, Jørgen Steen**, "County in opposition to demands from the Minister for Environment and Energy", newspaper article in "Information", **08.05.1995**, in Danish.
- Nielsen, Stefan Krüger, et al.**, "New environmental strategies? - an analysis of the environmental policy of the 1980'ties", Institute for Environment, Technology and Society, **1991**, in Danish.
- Nielsen, Sørger**, "Letter to the County of North Jutland with appeal to the EIA-procedure concerning the North Jutland Power Plant", **18.02.1993**.
- Nilson, Helene et. Al.**, "Environmental impact assessment and democracy", Institute for Environment, Technology and Society, Roskilde University, Denmark, **1996**.

- Organisation for Preservation of Nature**, "Letter to the County of Copenhagen", 23.8.1995, in Danish.
- SK Power**, "SK/DANGAS study - possibilities of using gas in the electricity sector", 1993, in Danish.
- SK Power**, "Application to the authorities to approve the establishment of the Avedøre 2 plant", 22.09.1994, in Danish.
- SK Power**, "Annual report 1994", 1994, in English.
- SK Power**, "SK Power's and ELKRAFT's comments to the comments given by the public in the public inquiry process", 29.04.1996, in Danish.
- SK Power**, "Evaluation of the demand and the environmental consequences of Avedøre 2 plant - SK Power's and ELKRAFT's comments to the report from the Danish Energy Agency of 24.06.1996", 28.06.1996, in Danish.
- SK Power**, "Press release: The rejection of the Avedøre 2 plant is a repercussion for Danish environmental policy", 28.06.1996.
- SK Power**, "Letter to the Minister for Environment and Energy, Svend Auken", 04.07.1996, in Danish.
- SK Power**, "Avedøre 2", 1997 (a), in English and Danish.
- SK Power**, "New revised application to build the Avedøre 2 plant", 11.03.1997, in Danish.
- SK Power**, "Letter to the County of Copenhagen: Elaboration of an environmental approval for AVV2", 16.04.1997, in Danish.
- SK Power**, "Letter to the County of Copenhagen: Supplementary information considering the environmental application for Avedøre 2", 15.05.1997, in Danish.
- SK Power**, "Letter to the County of Copenhagen: Supplementary information II considering the environmental application for Avedøre 2", 26.05.1997, in Danish.
- SK Power**, "Answer to question no. 54 raised by the Parliaments Energy Political Committee concerning when the implementation of the Avedøre 2 plant can be commenced", 03.02.1998, in Danish.
- Stiesdal**, Jane, "Action against reduction of the CO₂ 0,1DKr ", Article in "Energi og planlægning", in Danish.
- Tornbjerg**, Jesper, "Super power plant disappears in the fog", newspaper article in "Ingeniøren", 18.11.1994, in Danish.
- VEKS Heat Transmission Company**, "Growth in the expenses for heat for the consumers if the Avedøre 2 plant is not built, letter from VEKS to the Municipality of Hvidovre", 22.08.1996, in Danish.

Interviews:

- Preben Mac from the Municipality of Hvidovre, 12.05.1997.
- Jørgen Nørgaard from the Ecological Council, 12.05.1997.
- Morten Wiese from the County of Copenhagen, 14.05.1997.
- Sigurd Lauge Petersen from the Danish Energy Agency, 14.05.1997.
- Erik Knauerhase and Bjarne Hejlskov from the Energy Movement, 15.05.1997.
- Tarjei Haaland from Greenpeace Denmark, 20.05.1997.
- Erik Kjær Sørensen from SK Power and Henrik Lous from ELKRAFT, 02.07.1997.

Telephone interview:

- Telephone interview with Jesper Gundermann from the Danish Energy Agency, 17.02.1998.

Liste over tidligere udkomne tekster
tilsendes gerne. Henvendelse herom kan
ske til IMFUFA's sekretariat
tlf. 46 75 77 11 lokal 2263

-
- 217/92 "Two papers on APPLICATIONS AND MODELLING
IN THE MATHEMATICS CURRICULUM"
by: Mogens Niss
- 218/92 "A Three-Square Theorem"
by: Lars Kadison
- 219/92 "RUPNOK - stationær strømning i elastiske rør"
af: Anja Boisen, Karen Birkelund, Mette Olufsen
Vejleder: Jesper Larsen
- 220/92 "Automatisk diagnosticering i digitale kredsløb"
af: Bjørn Christensen, Ole Møller Nielsen
Vejleder: Stig Andur Pedersen
- 221/92 "A BUNDLE VALUED RADON TRANSFORM, WITH
APPLICATIONS TO INVARIANT WAVE EQUATIONS"
by: Thomas P. Branson, Gestur Olafsson and
Henrik Schlichtkrull
- 222/92 On the Representations of some Infinite Dimensional
Groups and Algebras Related to Quantum Physics
by: Johnny T. Ottesen
- 223/92 THE FUNCTIONAL DETERMINANT
by: Thomas P. Branson
- 224/92 UNIVERSAL AC CONDUCTIVITY OF NON-METALLIC SOLIDS AT
LOW TEMPERATURES
by: Jeppe C. Dyre
- 225/92 "HATMODELLEN" Impedansspektroskopi i ultrarent
en-krystallinsk silicium
af: Anja Boisen, Anders Gorm Larsen, Jesper Varmer,
Johannes K. Nielsen, Kit R. Hansen, Peter Bøggild
og Thomas Hougaard
Vejleder: Petr Viscor
- 226/92 "METHODS AND MODELS FOR ESTIMATING THE GLOBAL
CIRCULATION OF SELECTED EMISSIONS FROM ENERGY
CONVERSION"
by: Bent Sørensen

- 227/92 "Computersimulering og fysik"
af: Per M. Hansen, Steffen Holm,
Peter Maibom, Mads K. Dall Petersen,
Pernille Postgaard, Thomas B. Schrøder,
Ivar P. Zeck
Vejleder: Peder Voetmann Christiansen
- 228/92 "Teknologi og historie"
Fire artikler af:
Mogens Niss, Jens Høyrup, Ib Thiersen,
Hans Hedal
- 229/92 "Masser af information uden betydning"
En diskussion af informationsteorien
i Tor Nørretranders' "Mærk Verden" og
en skitse til et alternativ basseret
på andenordens kybernetik og semiotik.
af: Søren Brier
- 230/92 "Vinklens tredeling - et klassisk
problem"
et matematisk projekt af
Karen Birkelund, Bjørn Christensen
Vejleder: Johnny Ottesen
- 231A/92 "Elektrondiffusion i silicium - en
matematisk model"
af: Jesper Voetmann, Karen Birkelund,
Mette Olufsen, Ole Møller Nielsen
Vejledere: Johnny Ottesen, H.B. Hansen
- 231B/92 "Elektrondiffusion i silicium - en
matematisk model" Kildetekster
af: Jesper Voetmann, Karen Birkelund,
Mette Olufsen, Ole Møller Nielsen
Vejledere: Johnny Ottesen, H.B. Hansen
- 232/92 "Undersøgelse om den simultane opdagelse
af energiens bevarelse og isærdeles om
de af Mayer, Colding, Joule og Helmholtz
udførte arbejder"
af: L. Arleth, G.I. Dybkjær, M.T. Østergård
Vejleder: Dorte Posselt
- 233/92 "The effect of age-dependent host
mortality on the dynamics of an endemic
disease and
Instability in an SIR-model with age-
dependent susceptibility
by: Viggo Andreassen
- 234/92 "THE FUNCTIONAL DETERMINANT OF A FOUR-DIMENSIONAL
BOUNDARY VALUE PROBLEM"
by: Thomas P. Branson and Peter B. Gilkey
- 235/92 OVERFLADESTRUKTUR OG POREUDVIKLING AF KOKS
- Modul 3 fysik projekt -
af: Thomas Jessen
-

- 236a/93 INTRODUKTION TIL KVANTE
HALL EFFEKTEN
af: Anja Boisen, Peter Bøggild
Vejleder: Peder Voetmann Christiansen
Erland Brun Hansen
- 236b/93 STRØMSSAMMENBRUD AF KVANTE
HALL EFFEKTEN
af: Anja Boisen, Peter Bøggild
Vejleder: Peder Voetmann Christiansen
Erland Brun Hansen
- 237/93 The Wedderburn principal theorem and
Shukla cohomology
af: Lars Kadison
- 238/93 SEMIOTIK OG SYSTEMEGENSKABER (2)
Vektorbånd og tensorer
af: Peder Voetmann Christiansen
- 239/93 Valgsystemer - Modelbygning og analyse
Matematik 2. modul
af: Charlotte Gjerrild, Jane Hansen,
Maria Hermannsson, Allan Jørgensen,
Ragna Clauson-Kaas, Poul Lützen
Vejleder: Mogens Niss
- 240/93 Patologiske eksempler.
Om sære matematiske fisks betydning for
den matematiske udvikling
af: Claus Dråby, Jørn Skov Hansen, Runa
Ulsøe Johansen, Peter Meibom, Johannes
Kristoffer Nielsen
Vejleder: Mogens Niss
- 241/93 FOTOVOLTAISK STATUSNOTAT 1
af: Bent Sørensen
- 242/93 Brovedligeholdelse - bevar mig vel
Analyse af Vejdirektoratets model for
optimering af broreparationer
af: Linda Kyndlev, Kare Fundal, Kamma
Tulinus, Ivar Zeck
Vejleder: Jesper Larsen
- 243/93 TANKEEKSPERIMENTER I FYSIKKEN
Et 1.modul fysikprojekt
af: Karen Birkelund, Stine Sofia Korremann
Vejleder: Dorthe Posselt
- 244/93 RADONTRANSFORMATIONEN og dens anvendelse
i CT-scanning
Projektrapport
af: Trine Andreasen, Tine Guldager Christiansen,
Nina Skov Hansen og Christine Iversen
Vejledere: Gestur Olafsson og Jesper Larsen
- 245a+b
/93 Time-Of-Flight målinger på krystallinske
halvledere
Specialerapport
af: Linda Szkotak Jensen og Lise Odgaard Gade
Vejledere: Petr Viscor og Niels Boye Olsen
- 246/93 HVERDAGSVIDEN OG MATEMATIK
- LÆREPROCESSER I SKOLEN
af: Lena Lindenskov, Statens Humanistiske
Forskningsråd, RUC, IMFUFA
- 247/93 UNIVERSAL LOW TEMPERATURE AC CON-
DUCTIVITY OF MACROSCOPICALLY
DISORDERED NON-METALS
by: Jeppe C. Dyre
- 248/93 DIRAC OPERATORS AND MANIFOLDS WITH
BOUNDARY
by: B. Booss-Bavnbek, K.P.Wojciechowski
- 249/93 Perspectives on Teichmüller and the
Jahresbericht Addendum to Schappacher,
Scholz, et al.
by: B. Booss-Bavnbek
With comments by W.Abikoff, L.Ahlfors,
J.Cerf, P.J.Davis, W.Fuchs, F.P.Gardiner,
J.Jost, J.-P.Kahane, R.Lohan, L.Lorch,
J.Radkau and T.Söderqvist
- 250/93 EULER OG BOLZANO - MATEMATISK ANALYSE SET I ET
VIDENSKABSTEORETISK PERSPEKTIV
Projektrapport af: Anja Juul, Lone Michelsen,
Tomas Højgård Jensen
Vejleder: Stig Andur Pedersen
- 251/93 Genotypic Proportions in Hybrid Zones
by: Freddy Bugge Christiansen, Viggo Andreasen
and Ebbe Thue Poulsen
- 252/93 MODELLERING AF TILFÆLDIGE FÆNOMENER
Projektrapport af: Birthe Friis, Lisbeth Helmgård,
Kristina Charlotte Jakobsen, Marina Mosbæk
Johannessen, Lotte Ludvigsen, Mette Hass Nielsen
- 253/93 Kuglepakning
Teori og model
af: Lise Arleth, Kåre Fundal, Nils Kruse
Vejleder: Mogens Niss
- 254/93 Regressionsanalyse
Materiale til et statistikkursus
af: Jørgen Larsen
- 255/93 TID & BETINGET UAFHÆNGIGHED
af: Peter Harremoës
- 256/93 Determination of the Frequency Dependent
Bulk Modulus of Liquids Using a Piezo-
electric Spherical Shell (Preprint)
by: T. Christensen and N.B.Olsen
- 257/93 Modellering af dispersion i piezoelektriske
keramikker
af: Pernille Postgaard, Jannik Rasmussen,
Christina Specht, Mikko Østergård
Vejleder: Tage Christensen
- 258/93 Supplerende kursusbemærkninger til
"Lineære strukturer fra algebra og analyse"
af: Mogens Brun Heefelt
- 259/93 STUDIES OF AC HOPPING CONDUCTION AT LOW
TEMPERATURES
by: Jeppe C. Dyre
- 260/93 PARTITIONED MANIFOLDS AND INVARIANTS IN
DIMENSIONS 2, 3, AND 4
by: B. Booss-Bavnbek, K.P.Wojciechowski

- 261/93 OPGAVESAMLING
Bredde-kursus i Fysik
Eksamensopgaver fra 1976-93
- 262/93 Separability and the Jones Polynomial
by: Lars Kadison
- 263/93 Supplerende kursusmateriale til "Lineære strukturer fra algebra og analyse" II
af: Mogens Brun Heefelt
- 264/93 FOTOVOLTAISK STATUSNOTAT 2
af: Bent Sørensen
-
- 265/94 SPHERICAL FUNCTIONS ON ORDERED SYMMETRIC SPACES
To Sigurdur Helgason on his sixtyfifth birthday
by: Jacques Faraut, Joachim Hilgert and Gestur Olafsson
- 266/94 Kommensurabilitets-oscillationer i laterale supergitre
Fysikspeciale af: Anja Boisen, Peter Bøggild, Karen Birkelund
Vejledere: Rafael Taboryski, Poul Erik Lindelof, Peder Voetmann Christiansen
- 267/94 Kom til kort med matematik på Eksperimentarium - Et forslag til en opstilling
af: Charlotte Gjerrild, Jane Hansen
Vejleder: Bernhelm Booss-Bavnbek
- 268/94 Life is like a sewer ...
Et projekt om modellering af aorta via en model for strømning i kloakrør
af: Anders Marcussen, Anne C. Nilsson, Lone Michelsen, Per M. Hansen
Vejleder: Jesper Larsen
- 269/94 Dimensionsanalyse en introduktion metaprojekt, fysik
af: Tine Guldager Christiansen, Ken Andersen, Nikolaj Hermann, Jannik Rasmussen
Vejleder: Jens Højgaard Jensen
- 270/94 THE IMAGE OF THE ENVELOPING ALGEBRA AND IRREDUCIBILITY OF INDUCED REPRESENTATIONS OF EXPONENTIAL LIE GROUPS
by: Jacob Jacobsen
- 271/94 Matematikken i Fysikken. Opdaget eller opfundet NAT-BAS-projekt
vejleder: Jens Højgaard Jensen
- 272/94 Tradition og fornyelse
Det praktiske eleverbejde i gymnasiets fysikundervisning, 1907-1988
af: Kristian Hoppe og Jeppe Guldager
Vejledning: Karin Beyer og Nils Hybel
- 273/94 Model for kort- og mellemdistanceløb Verifikation af model
af: Lise Fabricius Christensen, Helle Pilemann, Bettina Sørensen
Vejleder: Mette Olufsen
- 274/94 MODEL 10 - en matematisk model af intravenøse anæstetikas farmakokinetik
3. modul matematik, forår 1994
af: Trine Andreasen, Bjørn Christensen, Christine Green, Anja Skjoldborg Hansen. Lisbeth Helmgård
Vejledere: Viggo Andreasen & Jesper Larsen
- 275/94 Perspectives on Teichmüller and the Jahresbericht 2nd Edition
by: Bernhelm Booss-Bavnbek
- 276/94 Dispersionsmodellering Projekttrapport 1. modul
af: Gitte Andersen, Rehannah Borup, Lisbeth Friis, Per Gregersen, Kristina Vejro
Vejleder: Bernhelm Booss-Bavnbek
- 277/94 PROJEKTARBEJDSPÆDAGOGIK - Om tre tolkninger af problemorienteret projektarbejde
af: Claus Flensted Behrens, Frederik Voetmann Christiansen, Jørn Skov Hansen, Thomas Thingstrup
Vejleder: Jens Højgaard Jensen
- 278/94 The Models Underlying the Anaesthesia Simulator Sophus
by: Mette Olufsen(Math-Tech), Finn Nielsen (RISØ National Laboratory), Per Føge Jensen (Herlev University Hospital), Stig Andur Pedersen (Roskilde University)
- 279/94 Description of a method of measuring the shear modulus of supercooled liquids and a comparison of their thermal and mechanical response functions.
af: Tage Christensen
- 280/94 A Course in Projective Geometry
by Lars Kadison and Matthias T. Kromann
- 281/94 Modellering af Det Cardiovasculære System med Neural Puls kontrol
Projekttrapport udarbejdet af:
Stefan Frello, Runa Ulsøe Johansen, Michael Poul Curt Hansen, Klaus Dahl Jensen
Vejleder: Viggo Andreasen
- 282/94 Parallell algoritmer
af: Erwin Dan Nielsen, Jan Danielsen, Niels Bo Johansen

- 283/94 Grænser for tilfældighed
(en kaotisk talgenerator)
af: Erwin Dan Nielsen og Niels Bo Johansen
- 284/94 Det er ikke til at se det, hvis man ikke
lige ve' det!
Gymnasiematematikens begrundelsesproblem
En specialerapport af Peter Hauge Jensen
og Linda Kyndlev
Vejleder: Mogens Niss
- 285/94 Slow coevolution of a viral pathogen and
its diploid host
by: Viggo Andreasen and
Freddy B. Christiansen
- 286/94 The energy master equation: A low-temperature
approximation to Bässler's random walk model
by: Jeppe C. Dyre
- 287/94 A Statistical Mechanical Approximation for the
Calculation of Time Auto-Correlation Functions
by: Jeppe C. Dyre
- 288/95 PROGRESS IN WIND ENERGY UTILIZATION
by: Bent Sørensen
- 289/95 Universal Time-Dependence of the Mean-Square
Displacement in Extremely Rugged Energy
Landscapes with Equal Minima
by: Jeppe C. Dyre and Jacob Jacobsen
- 290/95 Modellering af uregelmæssige bølger
Et 3.modul matematik projekt
af: Anders Marcussen, Anne Charlotte Nilsson,
Lone Michelsen, Per Mørkegaard Hansen
Vejleder: Jesper Larsen
- 291/95 1st Annual Report from the project
LIFE-CYCLE ANALYSIS OF THE TOTAL DANISH
ENERGY SYSTEM
an example of using methods developed for the
OECD/IEA and the US/EU fuel cycle externality study
by: Bent Sørensen
- 292/95 Fotovoltaisk Statusnotat 3
af: Bent Sørensen
- 293/95 Geometridiskussionen - hvor blev den af?
af: Lotte Ludvigsen & Jens Frandsen
Vejleder: Anders Madsen
- 294/95 Universets udvidelse -
et metaprojekt
Af: Jesper Duelund og Birthe Friis
Vejleder: Ib Lundgaard Rasmussen
- 295/95 A Review of Mathematical Modeling of the
Controlled Cardiovascular System
By: Johnny T. Ottesen
- 296/95 RETIKULER den klassiske mekanik
af: Peder Voetmann Christiansen
- 297/95 A fluid-dynamical model of the aorta with
bifurcations
by: Mette Olufsen and Johnny Ottesen
- 298/95 Mordet på Schrödingers kat - et metaprojekt om
to fortolkninger af kvantemekanikken
af: Maria Hermannsson, Sebastian Horst,
Christina Specht
Vejledere: Jeppe Dyre og Peder Voetmann Christiansen
- 299/95 ADAM under figenbladet - et kig på en samfunds-
videnskabelig matematisk model
Et matematisk modelprojekt
af: Claus Dræby, Michael Hansen, Tomas Højgård Jensen
Vejleder: Jørgen Larsen
- 300/95 Scenarios for Greenhouse Warming Mitigation
by: Bent Sørensen
- 301/95 TOK Modellering af træers vækst under påvirkning
af ozon
af: Glenn Møller-Holst, Marina Johannessen, Birthe
Nielsen og Bettina Sørensen.
Vejleder: Jesper Larsen
- 302/95 KOMPRESSORER - Analyse af en matematisk model for
aksialkompressor
Projektrapport sf: Stine Bøggild, Jakob Hilmer,
Pernille Postgaard
Vejleder: Viggo Andreasen
- 303/95 Masterlignings-modeller af Glasovergangen
Termisk-Mekanisk Relaksation
Specialerapport udarbejdet af:
Johannes K. Nielsen, Klaus Dahl Jensen
Vejledere: Jeppe C. Dyre, Jørgen Larsen
- 304a/95 STATISTIKNOTER Simple binomialfordelingsmodeller
af: Jørgen Larsen
- 304b/95 STATISTIKNOTER Simple normalfordelingsmodeller
af: Jørgen Larsen
- 304c/95 STATISTIKNOTER Simple Poissonfordelingsmodeller
af: Jørgen Larsen
- 304d/95 STATISTIKNOTER Simple multinomialfordelingsmodeller
af: Jørgen Larsen
- 304e/95 STATISTIKNOTER Mindre matematisk-statistisk opslagsværk
indeholdende bl.a. ordforklaringer, resuméer og
tabeller
af: Jørgen Larsen

- 305/95 The Maslov Index:
A Functional Analytical Definition
And The Spectral Flow Formula

By: B. Booss-Bavnbek, K. Furutani
- 306/95 Goals of mathematics teaching

Preprint of a chapter for the forthcoming International Handbook of Mathematics Education (Alan J. Bishop, ed)

By: Mogens Niss
- 307/95 Habit Formation and the Thirdness of Signs

Presented at the semiotic symposium

The Emergence of Codes and Intensions as a Basis of Sign Processes

By: Peder Voetmann Christiansen
- 308/95 Metaforer i Fysikken

af: Marianne Wilcken Bjerregaard, Frederik Voetmann Christiansen, Jørn Skov Hansen, Klaus Dahl Jensen, Ole Schmidt

Vejledere: Peder Voetmann Christiansen og Petr Viscor
- 309/95 Tiden og Tanken

En undersøgelse af begrebsverdenen Matematik udført ved hjælp af en analogi med tid

af: Anita Stark og Randi Petersen

Vejleder: Bernhelm Booss-Bavnbek
-
- 310/96 Kursusmateriale til "Lineære strukturer fra algebra og analyse" (E1)

af: Mogens Brun Heefelt
- 311/96 2nd Annual Report from the project
LIFE-CYCLE ANALYSIS OF THE TOTAL DANISH ENERGY SYSTEM

by: Hélène Connor-Lajambe, Bernd Kuemmel, Stefan Krüger Nielsen, Bent Sørensen
- 312/96 Grassmannian and Chiral Anomaly

by: B. Booss-Bavnbek, K.P. Wojciechowski
- 313/96 THE IRREDUCIBILITY OF CHANCE AND THE OPENNESS OF THE FUTURE

The Logical Function of Idealism in Peirce's Philosophy of Nature

By: Helmut Pape, University of Hannover
- 314/96 Feedback Regulation of Mammalian Cardiovascular System

By: Johnny T. Ottesen
- 315/96 "Rejsen til tidens indre" - Udarbejdelse af a + b
et manuskript til en fjernsynsudsendelse + manuskript

af: Gunhild Hune og Karina Goyle

Vejledere: Peder Voetmann Christiansen og Bruno Ingemann
- 316/96 Plasmaoscillation i natriumklynger

Specialerapport af: Peter Meibom, Mikko Østergård

Vejledere: Jeppe Dyre & Jørn Borggreen
- 317/96 Poincaré og symplektiske algoritmer

af: Ulla Rasmussen

Vejleder: Anders Madsen
- 318/96 Modelling the Respiratory System

by: Tine Guldager Christiansen, Claus Dråby

Supervisors: Viggo Andreassen, Michael Danielsen
- 319/96 Externality Estimation of Greenhouse Warming Impacts

by: Bent Sørensen
- 320/96 Grassmannian and Boundary Contribution to the -Determinant

by: K.P. Wojciechowski et al.
- 321/96 Modelkompetencer - udvikling og afprøvning af et begrebsapparat

Specialerapport af: Nina Skov Hansen, Christine Iversen, Kristin Troels-Smith

Vejleder: Morten Blomhøj
- 322/96 OPGAVESAMLING

Bredde-Kursus i Fysik 1976 - 1996
- 323/96 Structure and Dynamics of Symmetric Diblock Copolymers

PhD Thesis

by: Christine Maria Papadakis
- 324/96 Non-linearity of Baroreceptor Nerves

by: Johnny T. Ottesen
- 325/96 Retorik eller realitet ?

Anvendelser af matematik i det danske Gymnasiums matematikundervisning i perioden 1903 - 88

Specialerapport af Helle Pilemann

Vejleder: Mogens Niss
- 326/96 Bevist teori

Eksemplificeret ved Gentzens bevis for konsistensen af teorien om de naturlige tal

af: Gitte Andersen, Lise Mariane Jeppesen, Klaus Frovin Jørgensen, Ivar Peter Zeck

Vejledere: Bernhelm Booss-Bavnbek og Stig Andur Pedersen
- 327/96 NON-LINEAR MODELLING OF INTEGRATED ENERGY SUPPLY AND DEMAND MATCHING SYSTEMS

by: Bent Sørensen
- 328/96 Calculating Fuel Transport Emissions

by: Bernd Kuemmel

329/96 The dynamics of cocirculating influenza strains conferring partial cross-immunity and
A model of influenza A drift evolution
by: Viggo Andreassen, Juan Lin and Simon Levin

330/96 LONG-TERM INTEGRATION OF PHOTOVOLTAICS INTO THE GLOBAL ENERGY SYSTEM
by: Bent Sørensen

331/96 Viskøse fingre
Specialerapport af:
Vibeke Orlien og Christina Specht
Vejledere: Jacob M. Jacobsen og Jesper Larsen

332/97 ANOMAL SWELLING AF LIPIDE DOBBELTLAG
Specialerapport af:
Stine Sofia Korremann
Vejleder: Dorthe Posselt

333/97 Biodiversity Matters
an extension of methods found in the literature on monetisation of biodiversity
by: Bernd Kuemmel

334/97 LIFE-CYCLE ANALYSIS OF THE TOTAL DANISH ENERGY SYSTEM
by: Bernd Kuemmel and Bent Sørensen

335/97 Dynamics of Amorphous Solids and Viscous Liquids
by: Jeppe C. Dyre

336/97 PROBLEM-ORIENTATED GROUP PROJECT WORK AT ROSKILDE UNIVERSITY
by: Kathrine Legge

337/97 Verdensbankens globale befolkningsprognose - et projekt om matematisk modellering
af: Jørn Chr. Bendtsen, Kurt Jensen, Per Pauli Petersen
Vejleder: Jørgen Larsen

338/97 Kvantisering af nanolederes elektriske ledningsevne
Første modul fysikprojekt
af: Søren Dam, Esben Danielsen, Martin Niss, Esben Friis Pedersen, Frederik Resen Steenstrup
Vejleder: Tage Christensen

339/97 Defining Discipline
by: Wolfgang Coy

340/97 Prime ends revisited - a geometric point of view -
by: Carsten Lunde Petersen

341/97 Two chapters on the teaching, learning and assessment of geometry
by Mogens Niss

342/97 LONG-TERM SCENARIOS FOR GLOBAL ENERGY DEMAND AND SUPPLY
A global clean fossil scenario discussion paper prepared by Bernd Kuemmel
Project leader: Bent Sørensen

343/97 IMPORT/EKSPORT-POLITIK SOM REDSKAB TIL OPTIMERET UDNYTTELSE AF EL PRODUCERET PÅ VE-ANLÆG
af: Peter Meibom, Torben Svendsen, Bent Sørensen

344/97 Puzzles and Siegel disks
by Carsten Lunde Petersen
